A Case of Unintentional Overdose

Core Concepts:

- Acetaminophen is a pain medicine found in many over‐the‐counter medications and some prescription medications.
- Acetaminophen overdose can cause liver damage.
- Liver damage can lead to serious illness or death because the liver carries out many functions critical for maintaining homeostasis.
- Acetaminophen overdose can result from taking too much of one medicine.
- Acetaminophen overdose can result from taking two or more medicines that contain acetaminophen.

Class Time Required:
2‐3 forty minute class periods

Teacher Provides:

For each student
- Copy of student handout entitled A Case of an Unintentional Overdose
- Copy of General Safety Precautions. See page vii. Each student only needs a half sheet.

For each team of students
- Color copies of the three medicine labels. See pages viii through x.
- Laboratory Test Sheet—printed on plastic transparency. Each team only needs a half sheet. See page xi. Alternatively, you can print it on paper and place the paper strip into a plastic sheet protector.
- Color Charts for Laboratory Tests—printed in color. Each team only needs a half sheet. See page xii.
- 3 labeled droppers:
  - Luis Cordera Blood Plasma
  - Bilirubin Test Solution
  - Albumin Test Solution
- Small tube labeled Luis Cordera Blood Plasma containing at least 2 ml of pH 10 buffer solution. Purchase pH 10 buffer from a science supplier such as Ward’s Science. 
- Small tube labeled **Bilirubin Test Solution** containing at least 1 ml of 0.1% methyl red solution. Purchase methyl red from a science supplier such as Ward’s Science. [https://www.wardsci.com/store/catalog/product.jsp?product_id=8880637](https://www.wardsci.com/store/catalog/product.jsp?product_id=8880637)

- Small tube labeled **Albumin Test Solution** containing at least 1 ml of 0.1% bromothymol blue. Purchase bromothymol blue from science supplier such as Ward’s Science. [https://www.wardsci.com/store/catalog/product.jsp?product_id=8868613](https://www.wardsci.com/store/catalog/product.jsp?product_id=8868613)


**Teacher Resources:**


- **KnowYourDose.org** from the Acetaminophen Awareness Coalition provides a variety of resources including a report and an infographic on acetaminophen use. [http://www.knowyourdose.org/](http://www.knowyourdose.org/)

- **Acetaminophen-Savvy resource guide: tools for teen influencers** provides resources for teachers on the safe use of acetaminophen. [http://www.talkaboutrx.org/acetaminophen/teen-influencers-landing.jsp](http://www.talkaboutrx.org/acetaminophen/teen-influencers-landing.jsp)

- **Taking Acetaminophen Safely** is a YouTube video (approximately 2 minutes). It provides background about acetaminophen, a common over-the-counter pain reliever and fever reducer, and the many different types of medications that might contain acetaminophen; the danger of taking more acetaminophen than directed; how to learn if acetaminophen is in a medicine by looking at the Drug Facts label; and how to take acetaminophen safely [https://www.youtube.com/watch?v=cBDOx85Ywck](https://www.youtube.com/watch?v=cBDOx85Ywck)

- **Ten Tips to Prevent an Accidental Overdose** provides information on the importance of using the appropriate dosing devices when taking liquid medicine. [http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm253338.htm](http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm253338.htm)
Suggested Class Procedure:

1. Distribute a copy of *A Case of Unintentional Overdose* student instructions to each student.
2. Assign students to work in pairs to complete Part 1: Completing a Patient Record for Luis Cordera.
3. Several students read their answers to Part 1.
5. Assign students to work in pairs students to complete Part 2: Laboratory Tests for Luis Cordera.
6. Read the first two paragraphs of Part 2 aloud to class.
7. Distribute laboratory materials for Part 2 to each pair of students.
8. Students work with their partner and follow the instructions to complete Part 2.
9. Select students to read their answers to questions 19 and 20 in Part 2.
10. Distribute 3 medicine labels for Part 3.
11. Students work with their partner to complete Part 3: What Caused Luis Cordera’s Liver Damage?
12. Select students to share their answers to question 7 in Part 3.
13. Students work with their partner or individually to complete Part 4: Why is a Healthy Liver Important? Note that Part 4 may be done for homework.
14. Several students share their answers to questions 1 and 2 in Part 4.
15. Display student labels created in Part 4. Consider having students use post it notes to “vote” for the poster was most effective. For the poster they chose, they should write one feature of the poster that made it effective.
16. Optional: The multiple choice questions on pages iv-vi may be used for homework or as a quiz.

**Warning:** It is essential that you maintain families’ legal rights to privacy related to health and medicine use. Do not allow students to provide or discuss examples of medicines or dietary supplements used by their family members.

**Note:** The everyday use of the words “drugs”, “medicines”, and “dietary supplements” is different from the definitions used by the FDA (Food and Drug Administration). However, to help students relate the activity to their lives, we have used the words “drug” and “medicine” interchangeably.
Multiple Choice Questions – *A Case of Unintentional Overdose*

Base your answers to questions 1 through 4 on the information in the box below.

Acetaminophen is the most commonly used drug ingredient in America. It is found in over 600 over-the-counter (OTC) and prescription drugs. Many people don’t realize that acetaminophen found in a variety of their prescription and over-the-counter medicines, including pain relievers, fever reducers, and many cough and cold medicines.

When taken as directed, acetaminophen is safe and effective pain reliever and fever reducer. Like any medicine, however, there is a limit to how much should be taken in one day. The U.S. Food and Drug Administration (FDA) recommends a maximum daily dose of no more than 3,000 milligrams (mg) of acetaminophen.

Taking more acetaminophen than directed is an overdose and can lead to liver damage or death. An overdose occurs when a person takes too much acetaminophen at one time or takes a second dose before they are supposed to in an effort to help manage pain. Using multiple medications that contain acetaminophen can also result in an overdose. If a person takes an overdose of acetaminophen, they should seek prompt medical treatment by immediately contacting a doctor or a Poison Control Center.

1. Acetaminophen may be found in
   A. Over-the-counter medicines only.
   B. Prescription medicines only.
   C. Both over-the-counter and prescription medicines.

2. Taking more than the recommended amount of acetaminophen may result in
   A. Alcoholism.
   B. Liver damage.
   C. Fever and muscle aches.

3. An acetaminophen overdose may result when a person takes
   A. More than one medicine that contains acetaminophen.
   B. A medicine prescribed for another person.
   C. 2000 mg of acetaminophen per day.

4. If you suspect that someone has taken an acetaminophen overdose,
   A. It is a problem for children, but not for adults.
   B. Contact a doctor or a Poison Control Center immediately.
   C. Wait to see if you notice any unusual signs or symptoms.
Base your answers to questions 5 through 12 on the Adult Strength Acetaminophen Drug Facts label shown below.

<table>
<thead>
<tr>
<th>Drug Facts</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active ingredient (in each caplet)</strong></td>
<td><strong>Pain reliever/fever reducer</strong></td>
</tr>
<tr>
<td>Acetaminophen 500 mg</td>
<td></td>
</tr>
</tbody>
</table>

**Uses**
- Temporarily relieves minor aches and pains due to:
  - the common cold
  - headache
  - backache
  - minor pain of arthritis
  - muscular aches
  - toothache
  - premenstrual and menstrual cramps
- Temporarily reduces fever

**Warnings**
Liver warning: This product contains acetaminophen. Severe liver damage may occur if you take:
- More than 8 caplets in 24 hours, which is the maximum daily amount
- With other drugs containing acetaminophen
- 3 or more alcoholic drinks every day while using this product

Do not use with any other drug containing acetaminophen (prescription or nonprescription). If you are not sure whether a drug contains acetaminophen, ask a doctor or pharmacist.

Ask a doctor before use if you have liver disease
Ask a doctor or pharmacist before use if you are taking the blood thinning drug warfarin

Stop use and ask a doctor if:
- Pain gets worse or lasts more than 10 days
- New symptoms occur
- Fever gets worse or lasts more than 3 days
- Redness or swelling is present

These could be signs of a serious condition.

If pregnant or breast-feeding, ask a health professional before use.
Keep out of reach of children. In case of overdose, get medical help or contact a Poison Control Center right away (1-800-222-1222). Quick medical attention is critical for adults as well as for children even if you do not notice any signs or symptoms.

**Directions**
- Do not take more than directed (see Liver warning)
- Adults and children 12 years and over:
  - Take 2 caplets every 6 hours while symptoms last
  - Do not take more than 8 caplets in 24 hours
- Children under 12 years:
  - Do not use this adult product in children under 12 years of age; this will provide more than the recommended dose (overdose) and may cause liver damage

**Other information**
- Store at 20°-25°C (68°-77°F)

**Inactive ingredients**
- Carnauba wax*, croscarmellose sodium*, hypromellose, polyethylene glycol, povidone, sodium metabsulphite*, sodium starch glycolate*, starch, stearic acid. *May contain one or more of these ingredients

5. According to the information on the label, acetaminophen is
   A. An antihistamine.
   B. A muscle relaxant.
   C. A pain reliever and fever reducer.

6. How much acetaminophen is in one Adult Strength Acetaminophen caplet?
   A. 500 mg
   B. 1000 mg
   C. 5000 mg
7. What is considered a safe dose of Adult Strength Acetaminophen that an adult could safely take at one time?  
   A. 1 caplet  
   B. 2 caplets  
   C. 8 caplets  

8. How long should an adult wait before taking additional Adult Strength Acetaminophen caplets?  
   A. 4 hours  
   B. 6 hours  
   C. 8 hours  

9. What is the largest number of Adult Strength Acetaminophen caplets that an adult can safely take in a 24 hour period?  
   A. 4 caplets  
   B. 6 caplets  
   C. 8 caplets  

10. A person should consult a doctor before taking Adult Strength Acetaminophen if they  
     A. Consume three or more alcoholic beverages every day.  
     B. Are 12 years old and over.  
     C. Have been diagnosed with kidney disease.  

11. A person should not take Adult Strength Acetaminophen if they take  
     A. Dietary supplements  
     B. Herbal supplements  
     C. Other medicines that contain acetaminophen  

12. A person should stop taking Adult Strength Acetaminophen and contact their doctor if they experience  
     A. A fever that gets worse or lasts for more than 3 days  
     B. Pain that lasts for more than twenty four hours.  
     C. Nervousness and excitability  

13. When the liver stops functioning, it is a medical emergency that requires immediate treatment because  
     A. Treatment with albumin and alcohol can prevent liver damage.  
     B. A healthy liver is essential for maintaining homeostasis.  
     C. Patients with liver damage can only survive if they get an immediate liver transplant.  

14. Liver damage caused by acetaminophen is usually diagnosed by  
     A. Treating the patient with a medicine that destroys acetaminophen.  
     B. Taking X-rays of the patient’s liver.  
     C. Testing a patient’s blood plasma for high levels of bilirubin and liver enzymes.  

15. Albumin is a plasma protein made by the liver. Albumin is a protein needed to keep the correct amount of water in the blood and body tissues. Liver damage would result in  
     A. An increase in protein in the diet.  
     B. A decrease in albumin in the blood.  
     C. Dehydration due to high albumin levels.
General Safety Precautions

1. Work in a clean, uncluttered area. Cover the work area to protect the work surface.
2. Read and follow all instructions carefully.
3. Pay particular attention to following the specific safety precautions included in the instructions.
4. Wear safety goggles while performing experiments using chemicals.
5. Do not use droppers as “squirt guns”.
6. Never taste or ingest any chemicals used for this activity - they may be toxic.
7. Do not eat, drink, or apply make-up or contact lenses while performing experiments.
8. Wash your hands before and after performing experiments.
9. Chemicals used in experiments may stain or damage skin, clothing or work surfaces. If spills occur, wash the area immediately and thoroughly.
10. Follow your teacher’s instructions for end-of-experiment clean-up.
Medicine Labels for “A Case of Unintentional Overdose”

Drug Facts

Active Ingredients
(in each caplet) Purpose
Acetaminophen 600 mg Pain reliever/fever reducer

Uses: temporarily relieves minor aches and pains due to:
• headaches
• backache
• menstrual cramps

• muscle aches
• arthritis
• toothache
• the common cold

Warnings
Alcohol warning: If you consume 3 or more alcoholic beverages every day, ask your doctor whether you should take acetaminophen or other pain relievers/fever reducers. Acetaminophen may cause liver damage.

Do not use with any other products containing acetaminophen.

Stop use and ask your doctor if:
• new symptoms occur
• redness or swelling is present
• pain gets worse or lasts for more than 10 days
• fever gets worse or lasts for more than three days

If pregnant or breast-feeding, ask a health professional before use.

Keep out of reach of children.

Overdose warning: Taking more than the recommended dose (overdose) could cause serious health problems. In case of overdose, get medical help or contact a Poison Control Center right away. Quick medical attention is critical for adults as well as for children even if you do not notice any signs or symptoms.

Directions:
• do not take more than directed (see overdose warning)
• take 2 caplets every 4 to 6 hours as needed
• do not take more than 8 caplets in 24 hours

Children under 12 years: do not use this adult Extra Strength product in children under 12 years of age; this will provide more than the recommended dose (overdose) of acetaminophen and could cause serious health problems.

Other Information
• do not use if neck wrap or foil inner seal is broken or missing
• store at room temperature

Questions or comments?
Call toll free 1-800-XXX-XXXX
**Drug Facts**

**Active Ingredients**

(in each liquid-filled capsule)

- Acetaminophen, 325 mg...........fever reducer/pain reliever
- Dextromethorphan HBr, 15 mg.........cough suppressant
- Doxylamine Succinate, 625 mg............antihistamine

**Uses:** temporarily relieves these symptoms occurring with a cold, flu, hay fever, or other upper respiratory allergies:

- headaches
- minor aches and pains
- sore throat
- cough
- itchy, watery eyes
- runny nose
- itchy nose or throat

**Warnings**

**Liver warning:** This product contains acetaminophen. Severe liver damage may occur if you take:

- more than 8 capsules in any 24-hour period, which is the maximum daily amount
- with other drugs containing acetaminophen
- 3 or more alcoholic drinks every day while using this product.

**Do not use**

- if you are taking a prescription monoamine oxidase inhibitor (MAOI)(certain drugs for depression, psychiatric or emotional conditions, or Parkinson’s disease), or for two weeks after stopping these drugs. If you do not know if your prescription drug contains an MAOI, ask a doctor or a pharmacist before taking this drug.
- with any prescription or nonprescription drug containing acetaminophen

**Ask a doctor before use if you have:**

- liver disease
- glaucoma
- trouble urinating due to enlarged prostate gland
- coughing that occurs with too much phlegm (mucus)
- a breathing problem or chronic cough that lasts or occurs with smoking, asthma, chronic bronchitis, or emphysema

**Ask a doctor or pharmacist before use if you are taking:**

- the blood thinning drug warfarin
- any other pain reliever/fever reducer
- sedatives or tranquilizers

**When using this product:**

- marked drowsiness may occur
- avoid alcoholic drinks
- alcohol and sedatives may increase drowsiness
- be careful when driving a motor vehicle or operating machinery
- excitability may occur, especially in children

**Stop use and ask a doctor if**

- pain or cough gets worse or lasts for more than 7 days
- fever gets worse or lasts more than 3 days
- redness or swelling is present
- cough comes back or occurs with a rash or headache that lasts. These could be signs of a serious condition.
- new symptoms occur

**If pregnant or breast-feeding, ask a health professional before use.**

**Keep out of reach of children**

In case of overdose, get medical help or contact a Poison Control Center right away. Quick medical attention is critical for adults as well as for children even if you do not notice any signs or symptoms.

**Directions.**

- Do not take more than 8 capsules in any 24 hour period
- Do not exceed recommended dosage (Taking more than the recommended dose can cause serious liver damage.

<table>
<thead>
<tr>
<th>age</th>
<th>dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>adults and children 12 years and over</td>
<td>2 capsules every 6 hours</td>
</tr>
<tr>
<td>children under 12 years</td>
<td>do not use</td>
</tr>
</tbody>
</table>

**Other Information**

- do not use if neck wrap or foil inner seal is broken or missing
- store at room temperature

**Inactive ingredients**

- FD&C blue no. 1, gelatin, glycercin, pharmaceutical ink, polyethylene glycol, povidone, propylene glycol, purified water, sorbitol, sorbitan solution

**Questions or comments?**

Call toll free 1-800-XXX-XXXX
### Drug Facts

**Active Ingredients (in 15 ml TBSP)**
- Acetaminophen, 325 mg --- Fever reducer/pain reliever
- Dextromethorphan HBr, 15 mg --- Cough suppressant
- Doxylamine Succinate, 625 mg --- Antihistamine

**Uses:**
- temporarily relieves common cold/flu symptoms
- cough due to minor throat and bronchial irritation
- sore throat
- headache
- fever
- minor aches and pains
- runny nose and sneezing

**Warnings**

**Liver warning:** This product contains acetaminophen. Severe liver damage may occur if you take:
- more than 4 doses in any 24-hour period, which is the maximum daily amount
- other drugs containing acetaminophen
- 3 or more alcoholic drinks every day while using this product.

**Sore throat warning:** If sore throat is severe, lasts for more than 2 days, occurs with or is followed by fever, headache, rash, nausea, or vomiting, see a doctor promptly.

**Do not use**
- to make a child sleep
- with any prescription or nonprescription drug containing acetaminophen
- if you are taking a prescription monoamine oxidase inhibitor (MAOI) (certain drugs for depression, psychiatric or emotional conditions, or Parkinson's disease), or for two weeks after stopping these drugs. If you do not know if your prescription drug contains an MAOI, ask a doctor or a pharmacist before taking this drug.

**Ask a doctor before use if you have:**
- liver disease
- glaucoma
- a sodium restricted diet
- trouble urinating due to enlarged prostate gland
- cough that occurs with too much phlegm (mucus)
- a breathing problem or chronic cough that lasts or is as occurs with smoking, asthma, chronic bronchitis, or emphysema

**Ask a doctor or pharmacist before use if you are taking**
- the blood thinning drug warfarin
- sedatives or tranquilizers

### When using this product:
- do not use more than directed
- excitability may occur, especially in children
- marked drowsiness may occur
- avoid alcoholic drinks
- alcohol and sedatives may increase drowsiness
- be careful when driving a motor vehicle or operating machinery

### Stop use and ask a doctor if:
- pain or cough gets worse or lasts for more than 7 days
- fever gets worse or lasts more than 3 days
- redness or swelling is present
- cough comes back or occurs with a rash or headache that lasts. These could be signs of a serious condition.
- new symptoms occur

**If pregnant or breast-feeding,** ask a health professional before use.

**Keep out of reach of children**

**Overdose Warning** in case of overdose, get medical help or contact a Poison Control Center right away. Quick medical attention is critical for adults as well as for children even if you do not notice any signs or symptoms.

**Directions.**
- take only as directed
- use dose cup or tablespoon (TBSP)
- do not exceed 4 doses per 24 hours

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 years and over</td>
<td>30 ml (2TBSP) every 6 hours</td>
</tr>
<tr>
<td>children 4 to under 12 years</td>
<td>ask a doctor</td>
</tr>
<tr>
<td>children under 4 years</td>
<td>do not use</td>
</tr>
</tbody>
</table>

**Other Information**
- each tablespoon contains potassium 5 mg, sodium 18 mg
- store at room temperature

**Inactive ingredients**
- acesulfame potassium, alcohol, citric acid, FD&C yellow no. 10, FD&C green no. 3, flavor, high fructose corn syrup, polyethylene glycol, propylene glycol, purified water, saccharin sodium, and sodium citrate

**Questions or comments?**
Call toll free 1-800-XXX-XXXX

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<table>
<thead>
<tr>
<th>Laboratory Tests</th>
<th>Add 2 drops of Luis Cordera Blood Plasma to each circle.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma Bilirubin Test</td>
<td>Add 1 drop of Bilirubin Test Solution to this circle.</td>
</tr>
<tr>
<td>Plasma Albumin Test</td>
<td>Add 1 drop of Albumin Test Solution to this circle.</td>
</tr>
<tr>
<td>ALT Enzyme Test</td>
<td>Add one strip of ALT Test Paper to this circle.</td>
</tr>
</tbody>
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</tr>
</tbody>
</table>
### Color Charts for Laboratory Tests

#### Plasma Bilirubin Test

<table>
<thead>
<tr>
<th>Low</th>
<th>Normal</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Green</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

#### Plasma Albumin Test

<table>
<thead>
<tr>
<th>Low</th>
<th>Normal</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Purple</td>
<td>Red</td>
</tr>
</tbody>
</table>

#### ALT Enzyme Test

<table>
<thead>
<tr>
<th>Low</th>
<th>Normal</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Yellow</td>
<td>Dark Green</td>
</tr>
</tbody>
</table>
A Case of Unintentional Overdose

The Case

Two days ago, fourteen year-old Luis Cordera felt like he was coming down with the flu and had trouble sleeping. He took some over-the-counter medicines for his headache, cold symptoms, and insomnia (difficulty sleeping). Over-the-counter medicines are legal drugs that can be purchased without a prescription from a doctor. They can be purchased at pharmacies, grocery stores, or convenience stores.

Today at school, Luis began feeling nauseous and started vomiting. His stomach hurt, he was sweating excessively, and his heart felt like it was racing. Luis’s science teacher noticed that the whites of his eyes and his skin were yellowish, and he insisted that Luis go to the school nurse. The nurse called Luis’s parents and told them he should be taken immediately to the emergency room at a nearby hospital.

Part 1: Completing a Patient Record for Luis Cordera

1. Use The Case information above to complete a patient record for Luis Cordera. List at least 5 symptoms that Luis is experiencing at school.

   **General Hospital - Patient Record**
   
   **Date of Admission:** 2/12/2017  
   **Time of Admission:** 2:50 pm  
   **Patient Name:** Luis Cordera  
   **Gender:** Male  
   **Age:** 14 years  
   **Height:** 65 inches (165 cm)  
   **Weight:** 115 pounds (52.2 kilograms)  
   **Temperature:** 99 °F (37 °C)  
   **Heart Rate:** 100 beats per minute  

   **Symptoms:**
   - Nausea
   - Vomiting
   - Stomach ache
   - Excessive sweating
   - Rapid heartbeat
   - Whites of eyes have yellowish color
   - Skin has yellowish color
   - Headache
   - Difficulty sleeping

   *Student answers will vary. Accept the answer only if the student provides some evidence using the symptoms listed.*

2. Do you think that Luis has the “stomach flu” or some other health problem? Support your answer with evidence from the patient record.

   *Student answers may vary but nausea, vomiting, and stomach ache may be symptoms of stomach problems.*
Part 2: Laboratory Tests for Luis Cordera

The emergency room doctor noticed that Luis had a medical condition called jaundice. Jaundice results when too much bilirubin (pronounced BIL-eer-oo-bin), a yellow pigment, accumulates in the body. This causes the skin and the whites of the eyes to turn yellow. Bilirubin is processed by the liver so that it can be eliminated from the body.

Jaundice can happen for many reasons, such as blood diseases, liver diseases, digestive diseases, infections, and medicines. The doctor ordered laboratory tests on Luis’s blood to help determine what was causing Luis’s jaundice.

1. What is the name of the yellow pigment that builds up in the blood when a person has jaundice?

_Bilirubin_

2. List at least four things that can cause jaundice.

- **Blood diseases**
- **Liver diseases**
- **Digestive diseases**
- **Infections**
- **Medicines**

3. Why might the doctor want to conduct laboratory tests on Luis Cordera’s blood?

_To help the doctor determine what is causing Luis’ jaundice._

Follow the instructions on pages 3 and 4 to conduct each of the three laboratory tests that the doctor ordered. Record the results of the laboratory tests on the Data Table: Laboratory Test Results sheet on the last page of this handout. _Note: You may tear the Data Table page off to make it easier for you to record the results._
Plasma Bilirubin Test

4. Place two drops of Luis Cordera’s blood plasma sample onto the circle labeled “Plasma Bilirubin Test” on the Laboratory Test Sheet.

5. Add 1 drop of Bilirubin Test Solution to the plasma in the circle.

6. Use the Plasma Bilirubin Test color chart to determine the level of bilirubin in the plasma sample.

7. Record the results of the bilirubin test on the Data Table: Laboratory Test Results sheet.

8. What does the result of the plasma bilirubin test indicate about Luis Cordera’s health? Record the answer to this question in the last column of the Data Table: Laboratory Test Results sheet.

Plasma Albumin Test

9. Place two drops of Luis Cordera’s blood plasma sample onto the circle labeled “Plasma Albumin Test” on the Laboratory Test Sheet.

10. Add 1 drop of Albumin Test Solution to the plasma in the circle.

11. Use the Plasma Albumin Test color chart to determine the albumin level.

12. Record the results of the albumin test on the Data Table: Laboratory Test Results sheet.

13. What does the result of the plasma albumin test indicate about Luis Cordera’s health? Record the answer to this question in the last column of the Data Table: Laboratory Test Results sheet.
ALT Enzyme Test

14. Place two drops of Luis Cordera’s blood plasma sample onto the circle labeled “ALT Enzyme Test” on the Laboratory Test Sheet.

15. Add 1 strip of ALT Enzyme Test Paper to the plasma in the circle.

16. Use the ALT Enzyme Test color chart to determine the ALT enzyme level.

17. Record the results of the ALT enzyme test on Data Table: Laboratory Test Results sheet.

18. What does the result of the ALT enzyme test indicate about Luis Cordera’s health? Record the answer to this question in the last column of the Data Table: Laboratory Test Results sheet.

Conclusions

19. Based on all of the test results, what can you conclude is causing Luis Cordera’s jaundice? Support your conclusions with at least three pieces of evidence from the Data Table: Laboratory Test Results sheet.

   Liver problems or liver disease. Supported by bilirubin, low albumin, high ALT

20. Which of the three tests provides the best evidence that Luis has liver damage? Support your answer with information provided from the test.

   The ALT Enzyme Test because ALT is concentrated in liver tissue OR is a fairly specific indicator of liver damage.
Part 3: What Caused Luis Cordera’s Liver Damage?

The doctor explained that knowing what caused Luis’s liver damage would help him select the best treatment for Luis. The doctor asked Luis and his parents whether Luis had used alcohol, prescription medicines, over-the-counter medicines or illegal drugs during the last few days. Luis explained that he had only used over-the-counter medicines that were in his family’s medicine cabinet. All he had taken in the last few days were medicines for his headache, fever, flu symptoms, and some medicine to help him sleep. Luis also explained that he had been careful to read the directions and take only the dose that the label indicated.

Extra Strength Pain Reliever

Luis said that he took two Extra Strength Pain Reliever caplets when he woke up, two caplets at lunch time, two caplets at dinner time, and two caplets at bedtime.

1. Look at the Extra Strength Pain Reliever label. How many mg (milligrams) of acetaminophen were in all of the Extra Strength Pain Reliever caplets that Luis took? __4000 mg___
   Show your calculations in the space below.

   \[
   1 \text{ caplet} = 500 \text{ mg} \quad 2 \text{ caplets} = 1000 \text{ mg} \quad 2 \text{ caplets 4 times a day} = 4000 \text{ mg}
   \]

2. Did Luis follow the dosage instructions on the Extra Strength Pain Reliever label? _____Yes_____
   Support your answer with information from the label.

   The directions on the label say that adults can take two caplets every 4-6 hours or a total of 8 caplets a day. Students may point out that it would have been better if Luis had taken at specific times as indicated on the label.

Adult Cold and Flu Formula

Luis said he took two Adult Cold and Flu Formula capsules when he woke up, two capsules at lunch time, two capsules at dinner time, and two capsules at bedtime.

3. Look at the Adult Cold and Flu Formula label. How many mg (milligrams) of acetaminophen were in all of the Adult Cold and Flu Formula capsules that Luis took? __2600 mg_____
   Show your calculations in the space below.

   \[
   1 \text{ capsules} = 325 \text{ mg} \quad 2 \text{ capsules} = 650 \text{ mg} \quad 2 \text{ capsules 4 times a day} = 2600 \text{ mg}
   \]

4. Did Luis follow the dosage instructions on the Adult Cold and Flu Formula label? _____Maybe_____
   Support your answer with information from the label.

   The directions on the label say that you can take two capsules every 6 hours. Students may point out that it would have been better if Luis had taken at specific times as indicated on the label.
Nighttime Relief

Luis said he had been having trouble getting to sleep so he took 2 tablespoons (30 mL) of *Nighttime Relief* at 10:00 pm. When he was still awake at 11:00 pm, he took another 2 tablespoons.

5. Look at the *Nighttime Relief* label. How many mg (milligrams) of acetaminophen were in all of the *Nighttime Relief* liquid that Luis took? ____1300____ milligrams

   Show your calculations in the space below.
   
   \[1 \text{ TBSP (or 15 mL)} = 325 \text{ mg} \quad 4 \text{ TBSP (or 60 mL)} = 1300 \text{ mg}\]

6. Did Luis follow the instructions on the *Nighttime Relief* label? ____No____

   Support your answer with information from the label.

   *The directions on the label say that you can take two tablespoons (30 mL) every 6 hours and Luis took a second dose of medicine an hour after the first dose.*

The doctor explained that many people don’t realize that acetaminophen is found in many over-the-counter medicines, including pain relievers, fever reducers, and cough and cold medicines. While acetaminophen is safe and effective when used as directed, there is a limit to how much you should take in one day. Adults weighing over 50 kg (110 pounds) can take a maximum dose of 4,000 milligrams per day. Taking more acetaminophen than directed is an overdose that can lead to liver damage.

7. Luis weighs 115 pounds. Did Luis take an overdose of acetaminophen? ______Yes____

   Support your answer by calculating the total amount of acetaminophen Luis took. Show your work in the space below.

   - Extra Strength Pain Reliever  
     \[4000 \text{ mg}\]

   - Adult Cold and Flu Formula  
     \[2600 \text{ mg}\]

   - Nighttime Relief  
     \[1300 \text{ mg}\]

   - TOTAL =  
     \[7900 \text{ mg}\]

   *This is almost twice the recommended maximum daily dose of 4000 mg of acetaminophen.*
Some people do not realize that prescription medicines may also contain acetaminophen. Before taking over-the-counter pain medicines, it is important to read prescription labels or ask a doctor or a pharmacist to be sure the prescription medicine you are taking does not contain acetaminophen. On prescription medicine labels, acetaminophen is often listed as APAP.

8. Would it be safe for Luis to take Adult Cold and Flu Formula and the prescription medicine shown on the right? Explain why or why not.

   "NO because the medicine contains APAP which is another name for acetaminophen."

9. A new report from the Acetaminophen Awareness Coalition highlights common mistakes that patients often make when using acetaminophen:

   - **Taking more than the recommended dose for any of the medicines at a single time.**
     Did Luis do this for any of the medicines? Support your answer with specific information.
     
     "Luis took the dosage amounts indicated in the directions for each of the medicines."

   - **Taking the next dose too soon.**
     Did Luis do this? Support your answer with specific information.
     
     "He took the Nighttime Relief too soon. He should have waited 6 hours between doses but he took another dose after only 1 hour."

   - **Using multiple products with acetaminophen at the same time.**
     Did Luis do this? Support your answer with specific information.
     
     "Yes, Luis took three different medicines that contained acetaminophen."
Part 4: Why is a Healthy Liver Important?

The doctor told Luis’s parents that Luis’s condition was extremely serious. The results of Luis’s laboratory tests indicated that his liver was severely damaged. The doctor explained that when the liver stops functioning, it is a medical emergency that requires immediate treatment.

The liver is a large reddish brown organ that sits on the right side of the belly. A healthy liver is essential for maintaining homeostasis because it:

- Removes excess sugar and amino acids from the blood.
- Releases sugar into the blood when blood sugar levels are low.
- Removes waste products such as bilirubin, ammonia, and other toxins from the blood.
- Absorbs and stores fat, sugars, vitamins, iron, and other minerals.
- Produces cholesterol that is important for cell membrane structure.
- Produces important proteins such as albumin and blood clotting enzymes.
- Breaks down (metabolizes) alcohol and many drugs.

Homeostasis is a healthy state that is maintained by the constant adjustment of biochemical and physiological processes needed to keep the body stable enough to function properly. Failure to maintain homeostasis may result in illness or death.

1. List at least five ways in which liver damage result in a lack of homeostasis for Luis.

- **The blood may have too much or too little blood sugar.**
- **Toxins, bilirubin, or ammonia could build up in the blood.**
- **Nutrients would not be processed so that they could be used by the body.**
- **Vitamin A, iron and other minerals may not be stored.**
- **Cholesterol would not be produced.**
- **Albumin might not be produced.**
- **Blood clotting enzymes would not be produced.**
- **Alcohol and drugs would not be broken down.**
2. Do you think that Luis can survive if his liver does not begin functioning again? Explain why or why not.

_**No, he would not be able to maintain homeostasis. The liver performs many essential body processes.**_

A person who took an overdose of acetaminophen usually shows no symptoms until two days after the overdose. By then it may be too late for medical treatment to be effective, and liver damage could lead to death. Luis is very lucky because he received medical treatment within one day of his acetaminophen overdose.

Luis is responding well to treatment with Acetadote, a medicine used to treat acetaminophen overdoses. Luis has been in the hospital’s intensive care unit for four days. Recent tests indicate that Luis’s liver function is gradually returning to normal. He is expected to return home in a week or two.

For more information on acetaminophen overdose see:

- **MedlinePlus:** Acetaminophen Overdose  

- **eMedicine Health:** Acetaminophen (Tylenol) Poisoning  

3. Some products have safety warning labels to be certain that people understand the risks of using these products. On a separate sheet of paper, design an acetaminophen warning label that could be used on any medicine that contains acetaminophen. This label should:

- Be easily understood by someone with limited ability to read English.
- Make people aware that serious liver damage may result from an acetaminophen overdose.
### Data Table: Laboratory Test Results

<table>
<thead>
<tr>
<th>Laboratory Tests</th>
<th>Results (low, normal, or high)</th>
<th>Interpretation of Results: What do the results indicate about Luis Cordera’s liver function?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma Bilirubin Test</td>
<td>High</td>
<td>Higher than normal levels of bilirubin may indicate some type of liver problem or an increased rate of red blood cell destruction.</td>
</tr>
<tr>
<td>Plasma Albumin Test</td>
<td>Low</td>
<td>Lower than normal levels of albumin may indicate kidney disease or liver disease.</td>
</tr>
<tr>
<td>ALT Enzyme Test</td>
<td>High</td>
<td>Higher than normal levels of ALT enzyme may indicate some type of liver problem.</td>
</tr>
</tbody>
</table>