Nicotine Poisoning

Teacher Information

science take-out
just add students™

Summary

Follow a case of suspected nicotine poisoning in a young child.

- Determine if the child's symptoms are caused by nicotine poisoning.
- Use models to show why nicotine exposure is more dangerous for a child than an adult.
- Suggest changes to e-liquids and their packaging to reduce the risk of nicotine poisoning in children.
- Organize information for a media campaign to reduce the incidence of nicotine poisoning.

Core Concepts

- Nicotine in e-liquids and e-cigarettes is a dangerous toxin—particularly for young children.
- The effect of nicotine poisoning depends on the amount of nicotine and an individual's size.
- Nicotine product flavors and packaging may appeal to children and may lead to accidental poisoning.
- Media can be used to educate people on ways to prevent nicotine poisoning.

Time Required

- Part 1: 20 minutes
- Part 2: 20 minutes
- Part 3: 30 minutes

Kit Contains

- Nina's Urine Sample (simulated)
- Cotinine Test Strip (simulated)
- **Cell Phone Screens** pictures
- **Photos of Bottle of Purple e-Liquid**
- **E-Liquids Appeal to Children** sheet
- **Media Planning Sheet**
- Set of cards (A–J)
- Containers of liquid to represent an adult and a child
- Tube of simulated nicotine
- Dropper
- Red stirrer and black stirrer

Teacher Provides

- Calculator
- Safety goggles
- Paper towels for clean-up

Warning: Choking Hazard

This Science Take-Out kit contains small parts. Do not allow children under the age of seven to have access to any kit components.

Suggestions for Teachers

- The purpose of this kit is to make students aware that young children can be poisoned if they consume e-liquid (the fluid that is used in e-cigarettes) or other nicotine-containing products.
- The kit is designed to encourage discussions and questions related to the use of e-liquids. Encourage students to discuss their opinions, questions, and concerns.
- Be aware that your students, friends and family members may already use e-cigarettes. Having e-cigarettes in a home may put children at risk for nicotine poisoning.
- Also be aware that nicotine poisoning can happen in teens, particularly when they vape large amounts of nicotine in an attempt to get high. Teens call this "Nic-sick." Consider having your students do research on the symptoms of nicotine poisoning in teens.
- If you would like to know more about e-cigarettes and vaping before you use this kit with your students, the **Teacher Background Information** section below provides resources that contain background information.
- Teachers should be prepared to provide information on specific support services in their school and community to help students who want to quit vaping. Show this kit to people who provide these services before you use the kit with your students.
- Collaboration among counselors, health teachers, and science teachers is likely to increase the effectiveness of this kit.

The claim that "e-cigarettes are safer than cigarettes and can help smokers to quit" ignores important facts*:

- Most e-cigarettes contain nicotine. Nicotine is a poison. E-cigarette users may become addicted to nicotine.
- E-cigarette liquids contain a variety of potentially harmful substances such as flavorings and other chemicals.
- E-cigarette aerosol ("vapor") may include metals such as nickel, tin, and lead from the device itself. Inhaling these metals is hazardous.
- It is easy to manufacture "homemade" vaping fluids, so users may not know what chemicals they are vaping. Some homemade vaping fluids contain THC from marijuana.
- Not much is known about the safety of inhaling combinations of different chemical mixtures, and new vaping devices and vaping fluids are being marketed all the time.
- Regulators are working on policies to make sure e-cigarettes are safe, but the rapid changes in the e-cigarette market have outpaced regulation.

*Source: https://www.cdc.gov/vitalsigns/youth-tobacco-use/index.html

Part 1 Suggestions:

- Each kit includes one copy of the student instructions. Make additional copies as needed if students are sharing the kit with a partner.
- Consider laminating the separate handout sheets included in the kit so that they can be reused. Also consider protecting the labels on tubes, droppers, and containers by covering them with tape.
- This kit is based on an actual case, **E-Cigarette Liquid Nicotine Ingestion in a Child: Case Report and Discussion** https://pubmed.ncbi.nlm.nih.gov/25892642/
- Students will need the **Photos of Bottle of Purple e-liquid**, the bag with the **Cotinine Test Strip**, and the tube of **Nina's Urine Sample**.
- Students should discard the used Cotinine Test Strip. Save the bag for the Cotinine Test Strip and save the tube of Nina's Urine Sample.
- If students ask, "Who brought the bottle of Grape Vape into the house?" ask them to suggest and discuss possibilities—babysitter, parents, friends, relatives, etc.
- Students may need some support with the math calculations. Provide needed assistance so that this does not interfere with students' interest in the activity.

Part 2 Suggestions:

- Students will need the container labeled **Child**, container labeled **Adult**, tube of **Simulated Nicotine**, a **red stir stick**, and a **black stir stick**.
- At the end of Part 2, students should empty and rinse the inside of the Child and Adult containers thoroughly. *Do not get the labels on the outsides of the containers wet.* Tape could be placed over the labels to keep them dry. Do not empty the tube of Simulated Nicotine.

Part 3 Suggestions:

- Students will need the **E-Liquids Labels Appeal to Children** sheet, the **Media Planning Sheet**, and the **set of cards (A-J)**.
- Because the ideas on the cards overlap, student placement of cards on the Media Planning Sheet may differ. Students could share how they grouped the cards and explain why they might have grouped them differently.
- Consider having students share their ideas for regulating e-liquids, packaging, and bottles to reduce nicotine poisoning in children.

- Optional Extension: Students could work in teams to create and share media (brochures, videos, infographics, social media graphics, etc.) based on their media plan.
- Optional Extension: Nicotine poisoning may also kill pets. Consider using this social media story to make students aware of the effect of nicotine on pets. **Family devastated after dog dies from eating vape –** https://www.thatslife.com.au/family-devastated-after-dog-dies-from-eating-vape. Students could then do research on nicotine poisoning in pets.
- Optional Extension: Nicotine poisoning can happen to teens. Have students do research on the symptoms of nicotine poisoning in teens. They could use **What It Means to Be "Nic-Sick"** https://www.lung.org/blog/nic-sick as a source of information. Discuss what they should do if they or a friend experience nicotine poisoning.
- Optional Extension: **Use the What's Going On in This Graph? March 6, 2019** activity. The graph shows the use of tobacco products and e-cigarettes by students, from 2011 to 2018 – https://www.nytimes.com/2019/02/28/learning/whats-going-on-in-this-graph-march-6-2019.html

Teacher Background Information

- **CDC – Case Definition: Nicotine**
  https://emergency.cdc.gov/agent/nicotine/casedef.asp
- **Do You Vape? See These Tips for How to Keep e-Liquids Away from Children**
  https://www.fda.gov/consumers/consumer-updates/do-you-vape-see-these-tips-how-keep-e-liquids-away-children
- **FDA finalizes enforcement policy on unauthorized flavored cartridge-based e-cigarettes that appeal to children, including fruit and mint**
  https://www.fda.gov/news-events/press-announcements/fda-finalizes-enforcement-policy-unauthorized-flavored-cartridge-based-e-cigarettes-appeal-children
- **FDA, FTC take action against companies misleading kids with e-liquids that resemble children's juice boxes, candies and cookies**
  https://www.fda.gov/news-events/press-announcements/fda-ftc-take-action-against-companies-misleading-kids-e-liquids-resemble-childrens-juice-boxes
- **How FDA is Regulating E-Cigarettes**
  https://www.fda.gov/news-events/fda-voices/how-fda-regulating-e-cigarettes
- **E-Cigarette and Liquid Nicotine Exposures Among Young Children**
  https://pediatrics.aappublications.org/content/141/5/e20173361
- **E-Cigs and Toddlers: Beware**
  https://www.poison.org/articles/2013-sep/electronic-cigarettes

Reusing the Kit

Teachers will need to instruct students on how to handle cleanup and return of the reusable kit materials. For example, teachers might provide the following information for students:

Discard	Return to kit bag
Used Cotinine Test Strip Contents of the Adult and Child containers *You will need to rinse the insides of the Adult and Child containers thoroughly before you refill them. Do not get the labels wet!*	• Nina's Urine Sample • Bag for Cotinine Test Strip • **Cell Phone Screens** pictures • **Photos of Bottle of e-Liquid** • **E-Liquids Appeal to Children** sheet • **Media Planning Sheet** • Set of cards (A–J) • Adult and Child containers • Simulated Nicotine • Dropper • Red and black stirrers

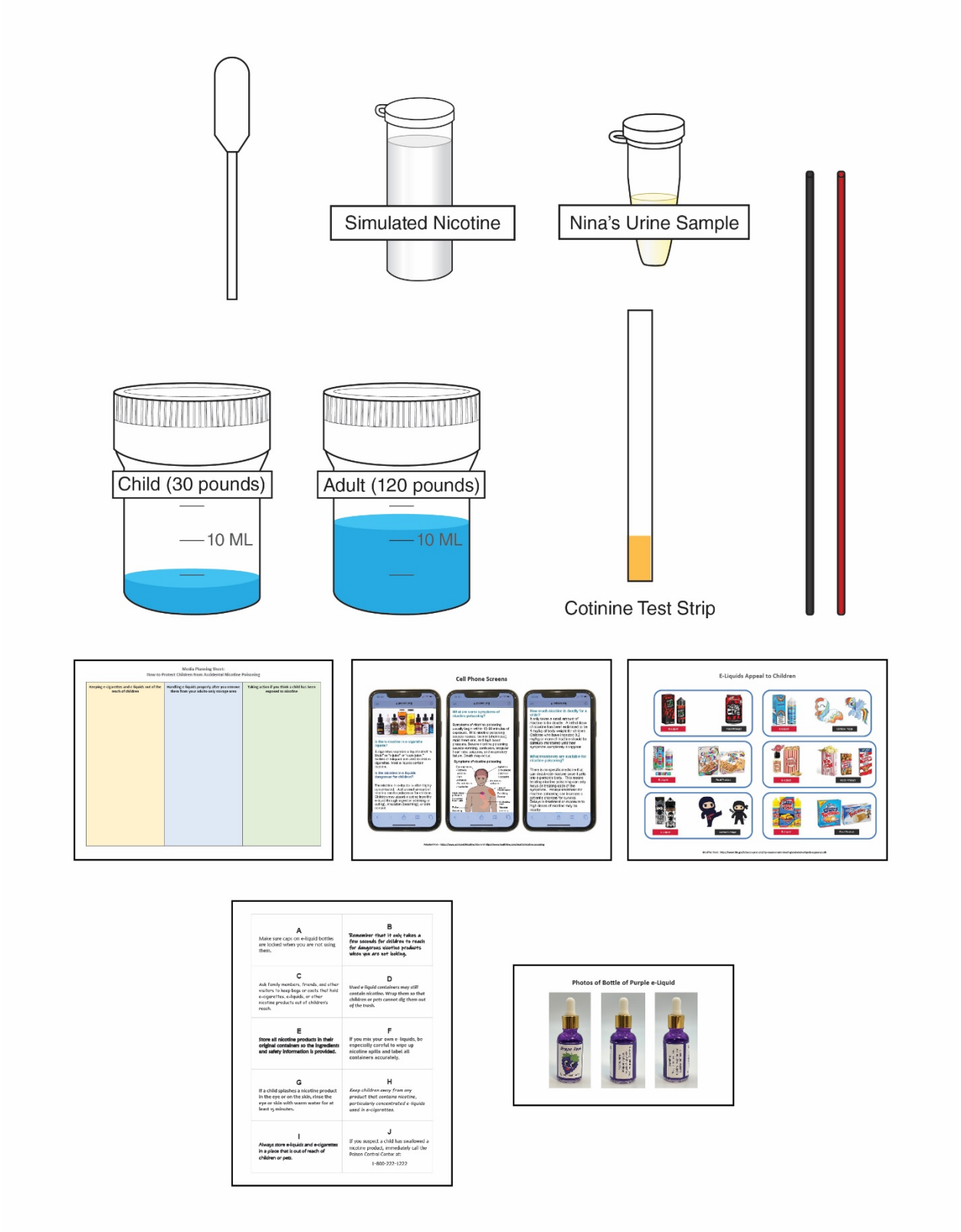
Hints:

- Do not get the labels wet when you rinse the containers. Consider covering the labels with tape.
- To avoid spills or loss of kit materials, have students clean up after Parts 1 and 2.
- Consider laminating the printed parts of the kits that will be reused.

Refills for the **Nicotine Poisoning** kits are available at www.sciencetakeout.com. The 10 Kit Refill Pack includes the following materials:

- 10 Cotinine Test Strips (simulated)
- 15 mL of Nina's Urine Sample (simulated)
- 20 mL of Simulated Nicotine
- 150 mL of liquid for refilling the Adult and Child containers

Kit Contents Quick Guide



Read these instructions before using Science Take-Out kits

Parental or Adult Supervision Required

This kit should be used only under the supervision of an adult who is committed to ensuring that the safety precautions below, and in the specific laboratory activity, are followed.

Chemicals Used in Science Take-Out Kits

Every effort has been made to reduce the use of hazardous chemicals in Science Take-Out kits. Most kits contain common household chemicals or chemicals that pose little or no risk. Safety Data Sheets (SDS) provide specific safety information regarding the chemical contents of the kits. SDS information for each kit is provided in the accompanying teacher instructions. We encourage students to adopt safe lab practices when performing laboratory activities involving chemicals.

Warning: Choking and Chemical Hazard

Science Take-Out kits contain small parts that could pose a choking hazard and chemicals that could be hazardous if ingested. Do not allow children under the age of seven to have access to any kit components.

No blood or body fluids from humans or animals are used in Science Take-Out kits. Chemical mixtures are substituted as simulations of these substances.

General Safety Precautions

1. Never taste, smell, or ingest any chemicals provided in the kit - they may be hazardous.
2. Chemicals used in Science Take-Out experiments may stain or damage skin, clothing or work surfaces. If spills occur, wash the area immediately and thoroughly.
3. Report any chemical spills or contact with chemicals to your teacher.
4. Work in a clean, uncluttered area. Cover the work area to protect the work surface.
5. Read and follow all instructions carefully.
6. Pay particular attention to following the specific safety precautions provided by your teacher or included in the kit activity instructions.
7. Do not use the contents of this kit for any other purpose beyond those described in the kit instructions.
8. Do not leave experiment parts or kits where they could be used inappropriately by others.
9. Do not eat, drink, or apply make-up or contact lenses while performing experiments.
10. Wash your hands before and after performing experiments.

Nicotine Poisoning

Teacher Answer Key

Part 1: A case of nicotine poisoning?

Two-year-old Nina was rushed to the hospital after her babysitter called 911. According to the babysitter, Nina suddenly started severe and frequent vomiting about an hour ago.

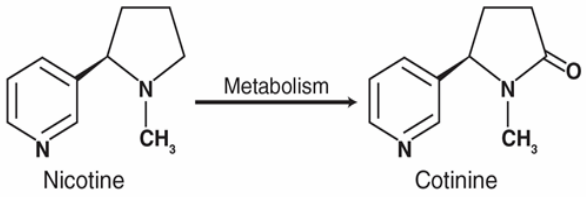
The hospital's emergency department staff noted that Nina was confused and shaky. She was vomiting frequently. Her heart rate was irregular. Her respiratory rate and blood pressure were above normal. They also observed purple stain on the girl's face and hands.

The babysitter gave the doctor a "Grape Vape" bottle that she found Nina holding. The bottle contained purple e-liquid ("vape juice") that had a grape odor. See the **Photos of Bottle of Purple e-Liquid** in your lab kit.

1. Explain why calling 911 was the correct thing for Nina's babysitter to do.

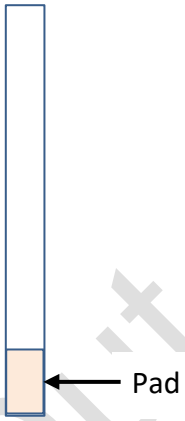
2. Explain why it was important that Nina's babysitter brought the bottle of "Grape Vape" e-liquid to the hospital emergency department.

The emergency department staff suspects that Nina might have nicotine poisoning from drinking the e-liquid. They want to test Nina's urine for the presence of cotinine, which is a chemical produced when the body metabolizes nicotine. The presence of cotinine in the body indicates that a person had nicotine in their body.



3. Follow the instructions below to test Nina's urine for cotinine.

   - Use the test strip from the bag labeled **Cotinine Test Strip.**
   - Dip the colored pad on a cotinine test strip into the liquid in the tube labeled **Nina's Urine Sample** as shown on the right.
   - Immediately remove the strip and check the color of the pad. If the pad turns green, it indicates that cotinine is present in Nina's urine.



4. Do the test results indicate that Nina might have ingested nicotine? Support your answer with evidence from the cotinine testing that you conducted.

Nina's babysitter was very worried! She overheard the nurses talking about nicotine poisoning. While she sat in the waiting room, she did an online search for more information on nicotine poisoning. The **Cell Phone Screens** sheet in your kit shows what Nina's babysitter found when she did an online search.

5. According to the information on the cell phone screens, does Nina have symptoms of mild or severe nicotine poisoning? Support your answer with Nina's symptoms and information from the cell phone screens.

6. According to the information on the cell phone screens, what can doctors do to help Nina survive nicotine poisoning?

7. It looked like only 1 teaspoon (5 ml) of the purple liquid was missing from the Grape Vape e-liquid bottle.

   a) According to the information on the Grape Vape bottle, how many milligrams (mg) of nicotine are in 1 milliliter (ml)?

   _____

   b) How many milligrams (mg) of nicotine would end up in Nina's body if she ingested (swallowed) 5 milliliters (ml) of Grape Vape e-liquid? Show your work.

   ml of Grape Vape ingested X mg of nicotine in 1 ml = mg of nicotine that Nina ingested

8. The babysitter wondered whether Nina might have swallowed a lethal dose of nicotine. She watched when the doctors weighed Nina, so she knew that Nina weighs 26.5 pounds or 12.0 kilograms (kg).

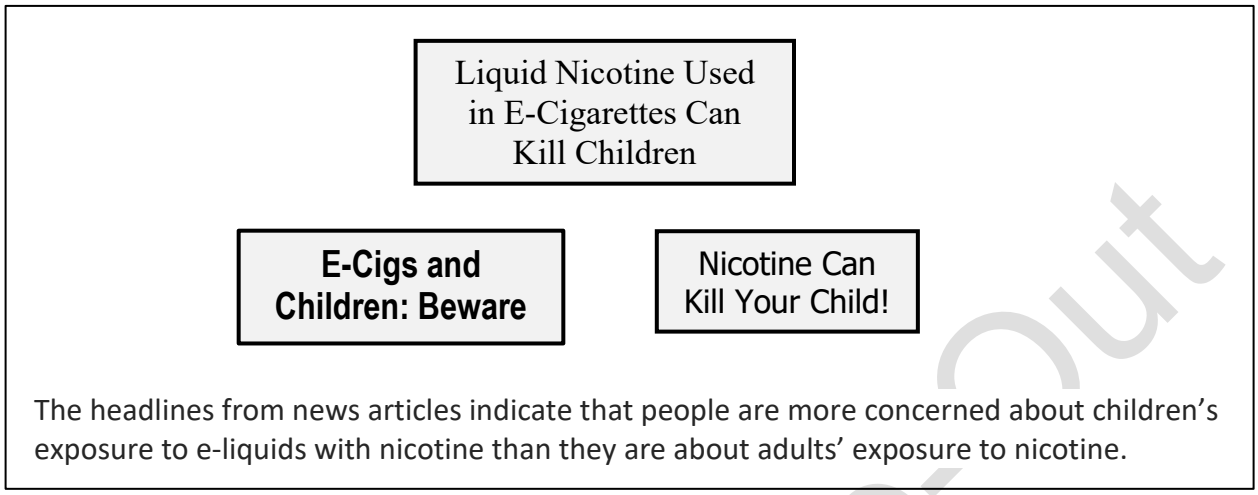
   a) What concentration (mg/kg) of nicotine would Nina have in her body if she ingested (swallowed) 5 ml of Grape Vape e-liquid? Show your work.

   $$\frac{\text{Amount of nicotine ingested (mg)}}{\text{Body weight (kg)}} = \text{Concentration (mg/kg)}$$

   b) According to the information on the cell phone screens, would 1 teaspoon (5 ml) of Grape Vape e-liquid be lethal for Nina? Explain why or why not.

To her parents' relief, Nina survived and was back to normal after several days. The doctors said that Nina was extremely lucky. They think that she swallowed far less than the one teaspoon (5ml) that was missing from the Grape Vape bottle. They suspect that most of the teaspoon of purple liquid was spilled or ended up on Nina's clothing.

Part 2: Why are people concerned about children and nicotine?



The headlines from news articles indicate that people are more concerned about children's exposure to e-liquids with nicotine than they are about adults' exposure to nicotine.

You will use a model to show why people are concerned about children's exposure to nicotine.

1. Use the container labeled **Child (30 pounds).** This container represents a child who weighs 30 pounds (approximately 13.6 kilograms).

2. <u>You will be counting the total number of drops of nicotine</u> that you add to the **Child** container to make the liquid turn from a blue color to an orange or yellow color. Blue or green liquid indicates the child is healthy. An orange or yellow color indicates a lethal (deadly) amount of nicotine.

   a) Use the small dropper to add 1 drop of the **Simulated Nicotine** to the **Child** container. ***Use the <u>red</u> stirrer to stir the contents for approximately 5 seconds.***

   b) Add 1 more drop of **Simulated Nicotine** to the **Child** container and use the red stirrer to stir the contents.

   c) Keep adding 1 drop at time of **Simulated Nicotine** ***(and stirring after each drop)*** until the liquid in the **Child** container changes from a blue color to an orange or yellow color.

   d) How many drops of **Simulated Nicotine** did it take to reach a lethal amount of nicotine for the 30-pound child?

Remember to count the drops of nicotine!

Note: When you are done with step 2, screw the lid onto the top of the Child container.

3. Use the container labeled **Adult (120 pounds)**. This container represents an adult who weighs 120 pounds (approximately 54.4 kilograms).

4. <u>You will be counting the total number of drops of nicotine</u> that you add to the **Adult** container to make the liquid turn from a blue color to an orange or yellow color. Blue or green liquid indicates the child is healthy. An orange or yellow color indicates a lethal (deadly) amount of nicotine.

   a) Use the small dropper to add 1 drop of the **Simulated Nicotine** to the **Adult** container. ***Use the <u>black</u> stirrer to stir the contents for approximately 5 seconds.***

   b) Add 1 more drop of **Simulated Nicotine** to the **Adult** container and use the black stirrer to stir the contents.

   c) Keep adding 1 drop at time of **Simulated Nicotine** ***(and stirring after each drop)*** until the liquid in the **Adult** container changes from a blue color to an orange or yellow color.

   d) How many drops of **Simulated Nicotine** did it take to reach a lethal amount for the 120-pound adult?

Note: When you are done with step 4, screw the lid onto the top of the Adult container.

5. What trend or pattern do you observe in the data you collected?

6. Why are people more concerned about children's exposure to nicotine than they are about adults' exposure to nicotine? Support your answer with evidence from the data you collected.

Part 3: Protecting children from nicotine poisoning

Base your answers to questions 1 through 3 on the **Photos of Bottle of Purple e-Liquid** and the **E-Liquids Appeal to Children** sheet that shows some examples of e-liquids and products they resemble.

1. List two characteristics of the "Grape Vape" bottle and the purple liquid that make it likely that children might drink the e-liquid.

2. The **E-Liquids Appeal to Children** sheet shows other examples of e-liquid containers and the products they resemble. List two reasons why these e-liquids appeal to children.

3. Identify one idea that you have for reducing the appeal of e-liquids to children.

Nina's parents joined a group that wants to have e-cigarettes and e-liquids regulated to prevent nicotine poisoning in children. Members of this group are concerned that e-liquids:

- Come in easy-to-open dropper bottles
- Have misleading packaging
- Have scents, flavors, or packaging to attract children

4. Describe one regulation that Nina's parents could suggest for each of the following:

   - Regulation of e-liquid ingredients

   - Regulation of e-liquid containers or bottles

   - Regulation of packaging or boxes for e-liquid bottles

Nina's parents and the group are also working to create media campaigns to make people aware of ways to prevent accidental nicotine poisoning from e-liquids and e-cigarettes. Group members submitted ideas for what should be included in the media campaigns. They need to organize their ideas to prepare for the media campaigns.

5. The set of cards (A–J) in your kit has ideas for ways to protect children from nicotine poisoning. Use the **Media Planning Sheet** in your kit to organize these cards into three categories.

6. Arrange the cards on the appropriate colored columns on the **Media Planning Sheet**. *For example, the "E. Store all nicotine products in their original containers" card could go in the blue column.*

7. Record your arrangement of the cards on the **Media Planning Sheet.** List the letters of the cards in each column.

   - *Keeping e-cigarettes and e-liquids out of the reach of children*

     Letters of the cards:

   - *Handling e-liquids properly after you remove them from your adults-only storage area*

     Letters of the cards:

   - *Taking action if you think a child has been exposed to nicotine*

     Letters of the cards: