

Appendix

Scenario #1: Grandfather, Granddaughter, and Caffeine

Part 1

Scenario: A thirteen-year-old girl and her grandfather walk into a café together. They each drink a large coffee. Thirty minutes later, the girl feels jittery and her hands are shaking. Her grandfather feels fine. They both consumed the same amount, or had the same exposure, of caffeine, but their responses were quite different. Apparently, one received a larger dose of caffeine than the other.

Question: How might you explain two very different effects in two people who have consumed the same amount of caffeine?

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Part 2

Question: Consider these facts. The girl weighs 36 kg (79 pounds) and her grandfather weighs 120 kg (264 pounds). A large coffee contains 360 mg of caffeine. Would you change your answer to the previous question based on these data?

Problem: Using these data, find a method to calculate the dose of caffeine that each person received. What dose of caffeine did each receive?

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Part 3

In other words, they both had equal exposures to caffeine, but the girl had a much higher dose—more than three times higher.

Prepare to summarize your findings to the whole class by answering these questions:

1. Who were the two individuals?
2. What chemical were they exposed to?
3. What was the effect on each individual—harmful, beneficial, or neither?
4. How did you calculate their respective doses?
5. What were their respective doses?

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Answer Key—Scenario #1: Grandfather, Granddaughter, and Caffeine

Part 1

Possible answers: one is bigger/smaller than the other, one is younger/older than the other, one is more/less sensitive, one is sick, one is male/female, one has built up a tolerance, etc.

Part 2

Answer: The girl's dose was 10 mg/kg; her grandfather's dose was 3.0 mg/kg.

Scenario #2: Husband, Wife, and Improperly Prepared Pufferfish

Part 1

Scenario: Fugu is a pufferfish used in Japanese cuisine that contains a potent neurotoxin called tetrodotoxin. This dish is harmless when prepared correctly by an expert chef, but when prepared improperly, it can cause death by paralysis.

A husband and wife go into a sushi restaurant and decide to be adventurous. They each have an order of fugu. Twenty minutes later, the wife is sweating heavily, complaining of headache, weakness, and shortness of breath. Her husband has numb, tingly lips. They both consumed the same amount, or had the same exposure, of tetrodotoxin, but their responses were quite different. Apparently, one received a larger dose of tetrodotoxin than the other.

Question: How might you explain two very different effects in two people who have consumed the same amount of tetrodotoxin?

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Part 2

Question: Consider these facts. The husband weighs 130 kg (286 pounds) and the wife weighs 65 kg (143 pounds). Their servings of pufferfish each contained 0.10 mg of tetrodotoxin. Would you change your answer to the previous question based on these data?

Problem: Using these data, find a method to calculate the dose of tetrodotoxin that each person received. What dose of tetrodotoxin did each receive?

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Part 3

In other words, they both had equal exposures to tetrodotoxin, but the wife had a much higher dose—twice as high.

Prepare to summarize your findings to the whole class by answering these questions:

1. Who were the two individuals?
2. What chemical were they exposed to?
3. What was the effect on each individual—harmful, beneficial, or neither?
4. How did you calculate their respective doses?
5. What were their respective doses?

----- Cut Here -----

Answer Key—Scenario #2: Husband, Wife, and Improperly Prepared Pufferfish

Part 1

Possible answers: one is bigger/smaller than the other, one is younger/older than the other, one is more/less sensitive, one is sick, one is male/female, one has built up a tolerance, etc.

Part 2

Answer: The husband's dose was 0.00080 mg/kg; the wife's dose was 0.0015 mg/kg.

Scenario #3: Mom and Baby Take Baby Tylenol

Part 1

Scenario: A young mother and her one-year-old baby both have a fever. The mother gives her baby 0.8 ml of acetaminophen drops (“Infant’s Tylenol”). She doesn’t have any adult acetaminophen pills, so she gives herself 0.8 ml of the baby drug, too. Thirty minutes later, the baby has stopped crying and settles down to sleep. His mother is relieved that the baby seems better, but her fever doesn’t feel any better. They both took the same amount, or had the same exposure, of acetaminophen, but their responses were quite different. Apparently, one received a larger dose of acetaminophen than the other.

Question: How might you explain two very different effects in two people who have consumed the same amount of acetaminophen?

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Part 2

Question: Consider these facts. The baby weighs 7.2 kg (16 pounds) and his mother weighs 72 kg (158 pounds). A dropper of 0.8 ml contains 80 mg of acetaminophen. Would you change your answer to the previous question based on these data?

Problem: Using these data, find a method to calculate the dose of acetaminophen that each person received. What dose of acetaminophen did each receive?

----- Cut Here -----

Part 3

In other words, they both had equal exposures to acetaminophen, but the mother had a much lower dose—ten times lower.

Prepare to summarize your findings to the whole class by answering these questions:

1. Who were the two individuals?
2. What chemical were they exposed to?
3. What was the effect on each individual—harmful, beneficial, or neither?
4. How did you calculate their respective doses?
5. What were their respective doses?

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Answer Key—Scenario #3: Mom and Baby Take Baby Tylenol

Part 1

Possible answers: one is bigger/smaller than the other, one is younger/older than the other, one is more/less sensitive, one is sicker, one is male/female, one has built up a tolerance, etc.

Part 2

Answer: The baby’s dose was 11 mg/kg; his mother’s dose was 1.1 mg/kg.

Scenario #4: Mom and Baby Take Adult Tylenol

Part 1

Scenario: A young mother and her one-year-old baby both have a fever. The mother takes an adult acetaminophen tablet (“Tylenol”). She doesn’t have any infant acetaminophen drops, so she unwisely gives the baby an adult tablet, too. Thirty minutes later, her fever feels better, but the baby’s distress is even worse than before, and he is vomiting. A trip to the emergency room is necessary to save his life!

Mother and baby both took the same amount, or had the same exposure, of acetaminophen, but their responses were quite different. Apparently, one received a larger dose of acetaminophen than the other.

Question: How might you explain two very different effects in two people who have consumed the same amount of acetaminophen?

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Part 2

Question: Consider these facts. The baby weighs 7.2 kg (16 pounds) and his mother weighs 72 kg (158 pounds). An adult pill contains 325 mg of acetaminophen. Would you change your answer to the previous question based on these data?

Problem: Using these data, find a method to calculate the dose of acetaminophen that each person received. What dose of acetaminophen did each receive?

----- Cut Here -----

Part 3

In other words, they both had equal exposures to acetaminophen, but the baby had a much higher dose—ten times higher!

Prepare to summarize your findings to the whole class by answering these questions:

1. Who were the two individuals?
2. What chemical were they exposed to?
3. What was the effect on each individual—harmful, beneficial, or neither?
4. How did you calculate their respective doses?
5. What were their respective doses?

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Answer Key—Scenario #4: Mom and Baby Take Adult Tylenol

Part 1

Possible answers: one is bigger/smaller than the other, one is younger/older than the other, one is more/less sensitive, one is sicker, one is male/female, one has built up a tolerance, etc.

Part 2

Answer: The baby’s dose was 45 mg/kg; his mother’s dose was 4.5 mg/kg.

Scenario #5: Husband and Wife Vitamin Overdose

Part 1

Scenario: Many people living in high latitudes don't make enough vitamin D within their bodies. Concerned that they don't have healthy vitamin D levels, a husband and wife decide that they will both take daily vitamin D supplements. They each take ten pills a day. After a few weeks, the husband is slightly ill, with a low appetite and nausea. The wife also experiences a loss of appetite and nausea, as well as excessive thirst and urination. Her doctor diagnoses kidney problems due to very high blood levels of calcium.

Both the husband and the wife have been taking the same daily amount, or have had the same daily exposure, of vitamin D, but their responses were quite different. Apparently, one received a larger daily dose of vitamin D than the other.

Question: How might you explain two very different effects in two people who have consumed the same amount of vitamin D?

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Part 2

Question: Consider these facts. The husband weighs 130 kg (286 pounds) and the wife weighs 65 kg (143 pounds). Each pill contains 0.125 mg of vitamin D, so by taking ten pills, both consume 1.25 mg per day. Would you change your answer to the previous question based on these data?

Problem: Using these data, find a method to calculate the dose of vitamin D that each person received. What dose of vitamin D did each receive?

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Part 3

In other words, they both had equal exposures to vitamin D, but the wife had a much higher dose—twice as high.

Prepare to summarize your findings to the whole class by answering these questions:

1. Who were the two individuals?
2. What chemical were they exposed to?
3. What was the effect on each individual—harmful, beneficial, or neither?
4. How did you calculate their respective doses?
5. What were their respective doses?

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Answer Key—Scenario #5: Husband and Wife Vitamin Overdose

Part 1

Possible answers: one is bigger/smaller than the other, one is younger/older than the other, one is more/less sensitive, one is sick, one is male/female, one has built up a tolerance, etc.

Part 2

Answer: The husband's daily dose was 0.0096 mg/kg each day; the wife's daily dose was 0.019 mg/kg each day.

Scenario #6: Husband and Wife Vitamin Deficiency

Part 1

Scenario: Many people who live at high latitudes, spend most of their time inside, and protect themselves from sunlight do not produce enough vitamin D within their bodies. A husband and wife eat a diet that they think is healthy, but it contains low levels of vitamin D. Eventually, the husband begins to complain of pain and weakness in limbs, and his doctor diagnoses osteoporosis and osteomalacia (weak bones). His wife doesn't have any symptoms.

Both the husband and the wife have been consuming the same daily amount, or have had the same daily exposure, of vitamin D, but their responses were quite different. Apparently, one received a larger daily dose of vitamin D than the other.

Question: How might you explain two very different effects in two people who have consumed the same amount of vitamin D?

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Part 2

Question: Consider these facts. The husband weighs 130 kg (286 pounds) and the wife weighs 65 kg (143 pounds). Their meals on a typical day contain a total of 0.0015 mg of vitamin D. Would you change your answer to the previous question based on these data?

Problem: Using these data, find a method to calculate the dose of vitamin D that each person received. What dose of vitamin D did each receive?

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Part 3

In other words, they both had equal exposures to vitamin D, but the husband had a much lower dose—half as much.

Prepare to summarize your findings to the whole class by answering these questions:

1. Who were the two individuals?
2. What chemical were they exposed to?
3. What was the effect on each individual—harmful, beneficial, or neither?
4. How did you calculate their respective doses?
5. What were their respective doses?

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Answer Key—Scenario #6: Husband and Wife Vitamin Deficiency

Part 1

Possible answers: one is bigger/smaller than the other, one is younger/older than the other, one is more/less sensitive, one is sick, one is male/female, one has built up a tolerance, etc.

Part 2

Answer: The husband's daily dose was 0.000012 mg/kg each day; the wife's daily dose was 0.000023 mg/kg each day.