

Name: _____ Period: _____ Date: _____

Blood Groups Case Study

Sunday Afternoon

It's another beautiful day in Springfield and the Simpson family has decided to take a family outing to the Springfield Clinic to have their blood types tested. A few pin-pricks later, they have their information, which is summarized in the table below. (If you've been marooned on a deserted island without TV reception for the past 20 years: Homer and Marge are the parents; Bart, Lisa and Maggie are their three children.)

Complete the table.

| Simpson | Blood Type | RBC Antigens | Plasma Antibodies |
|---------|-------------|--------------|-------------------|
| Homer | A-negative | | |
| Marge | B-positive | | |
| Bart | O-positive | | |
| Lisa | A-negative | | |
| Maggie | AB-negative | | |

Monday Afternoon

The following day, tragedy strikes as Bart rushes home from school on his skateboard. Approaching an intersection, he fails to use proper safety procedures and he careens into the intersection without looking both ways. Before he can utter, "Ay, Caramba!" a speeding car hits Bart, sending him flying into the air. The car doesn't even slow down as the figure in the passenger seat asks the driver, "Smithers, did you feel something?" Smithers shrugs and replies, "Probably just a pothole, sir."

Unfortunately, Bart has also failed to wear proper safety equipment and he is badly hurt in the accident. A passerby calls an ambulance and Bart is rushed to Springfield Hospital. "Bart has lost a lot of blood, and he's going to need a transfusion." Dr. Hibbert explains to Homer and Marge. "But unfortunately, the Springfield Blood Bank has had to close because of the governor's budget cuts."

Marge gasps in horror. "Oh, my special little guy! Homer and I will give blood for Bart's transfusion! So will Lisa!"

"No!" exclaims Lisa. "You can't give blood to Bart! None of us can!"

"Lisa!" shouts Homer. "Bart is your brother and you *love* him. You'll give him your blood for his transfusion and that's that! Every drop!"

"You don't understand!" replies Lisa. "None of us can give our blood to Bart because..."
(Complete Lisa's explanation in the space below)

Name: _____ Period: _____ Date: _____

“D’oh!” exclaims Homer as he hears, but doesn’t really understand, Lisa’s explanation. “What’s to become of the boy?!”

“What’s this?” muses Dr. Hibbert as he pulls two plastic bags containing red liquid from his lab coat pocket. “Why, this looks like those pints of blood I took from the blood bank before it closed last week. I wondered where they went!” Dr. Hibbert chuckles jovially. “Now if only I could remember what blood type they are. Now I wish I hadn’t torn off the labels!”

Dr. Hibbert rushes to the lab to type the mystery blood with anti-sera. “They both taste like the right blood type,” he muses to himself. “But I’d better be sure. Malpractice lawsuits can be so expensive these days!” He tests a small amount of each unknown with the results shown in the following table.

Complete the table.

| Sample | Anti-A serum | Anti-B serum | Anti-Rh serum | Blood type | OK for Bart? |
|--------|------------------|------------------|------------------|------------|--------------|
| 1 | Agglutination | Agglutination | No agglutination | | |
| 2 | No agglutination | No agglutination | No agglutination | | |

Grabbing the correct packet of blood, Dr. Hibbert performs the transfusion and Bart is saved!

Monday Night

Bart has to spend the night in the hospital, but the rest of the Simpsons return home exhausted. Lisa flops on the bed and immediately falls asleep. After the day’s events, it’s no wonder that she dreams about blood types.

In her dream, Lisa listens intently as her second grade teacher Miss Hoover gives a detailed explanation of Mendelian genetics and how it determines the antigens expressed in erythrocyte plasma membranes. Lisa wakes and sits bolt upright. “It’s so amazingly simple!” she exclaims. “I’ll bet I can figure out my whole family’s ABO and Rh genotypes just by knowing their phenotypes!”

Lisa starts to complete a table with the family’s blood type genotypes, but she falls asleep before completing the table. Help her complete it. (Hints: Each genotype will have four alleles – two for the ABO group and two for the Rh group. Figure out the ABO alleles separate from the Rh alleles. Start with Maggie and Bart, in that order. And don’t forget that each Simpson child got one ABO allele and one Rh allele from each parent.)

| Simpson | Phenotype | Genotype |
|---------|-------------|----------|
| Homer | A-negative | |
| Marge | B-positive | |
| Bart | O-positive | |
| Lisa | A-negative | |
| Maggie | AB-negative | |

Name: _____ Period: _____ Date: _____

Tuesday Afternoon

It will take some time for Bart's wounds to heal, but since he's not in critical condition anymore, Springfield Fly By Night Medical Insurance Group, Ltd., a wholly-owned subsidiary of the Montgomery Burns Power Company, has ordered that Bart be discharged from the hospital. At home that night, Bart is his usual petulant self.

"Thanks for nothing, Lis!" he quips. "At least I know that if you ever need blood I can't give you my blood either!"

"Oh, but you can, dear brother!" smirks Lisa. "At least you could one time."

"Huh?" Bart is confused. "What do you mean one time?"

"Well," begins Lisa. "You could donate blood to me the first time because..." (complete Lisa's response.)

"Well I still wouldn't do it!" Bart snaps, defiantly. "But even if I did, why couldn't I do it a second time?"

"Well, that's because..." (complete the rest of Lisa's response.)

"Well, then, I guess you better be nice to me, or else I might sneak up on you when you least expect it and donate blood to you twice!"

Wednesday Morning

"Hey, Liiiiisa!"

Lisa cringes as she hears Milhouse's voice across the schoolyard.

"Hey, Lisa!" Milhouse spouts breathlessly as he runs up to her. "Want to see what I found?"

"Uh, sure." Lisa responds, not really caring what species of herptile Milhouse has ripped from its natural habitat this time. "But first, just out of curiosity, do you know what your blood type is?"

"Yup!" Milhouse beams. "I'm B-positive! My mom says that's because I like to *be so positive!* Get it?" Milhouse elbowed Lisa in the ribs. "Get it?" Lisa laughs politely.

Name: _____ Period: _____ Date: _____

Milhouse holds up a crystal sphere about the size of a softball. It seems to be glowing slightly. "It's a crystal ball!" he announces. "It can show you the future. Want to see *our* future?" He wags his eyebrows at Lisa.

Not seeing any way to avoid it, Lisa shrugs and nods. She looks into the crystal ball and sees fifteen years into the future. In this future, she is married to, "oh no!," Milhouse. And they have a son! And, even worse, she is pregnant with a second child!

"Oh no!" gasps Lisa. "Do you know what our son's blood type is?" she asks.

"Well," responds Milhouse. "I'll bet he's B-positive. Just like his old man!"

"Oh," Lisa moans dejectedly. "I guess that means his genotype is _____. But what blood type is the fetus?"

"That's B-positive, too! B-positive rules!" Milhouse pumps a fist in the air. "My dad is B-positive, too, but my mom is O-negative."

Lisa barely hears Milhouse's rambling as she gazes into the crystal ball. She sees the hazy image shift to a scene several months later. In it, she sees a much older Dr. Hibbert standing over her. "I'm sorry," he says. "But your second child has..." The soundtrack that Lisa hadn't even noticed before becomes ominous. "hemolytic disease of the newborn!"

Explain why this child might have HDN while the first child did not.

"Noooooooooooo!" Lisa screams as she knocks the crystal ball from Milhouse's hand. "That could never happen!" she insists. "I know our blood types so I'd get RhoGAM injections!"

"Huh?" asks Milhouse. "What's a Row Gum? And what do you know about blood types?"

"I don't just know your blood type," replied Lisa, "But I also know your genotype! It's _____."

"I'm a big eye bee what??" Milhouse sputtered in confusion.

"Just leave me alone, Mr. Be Posititive!" Lisa storms away and shouts over her shoulder, "And keep your alleles to yourself!"

The end.