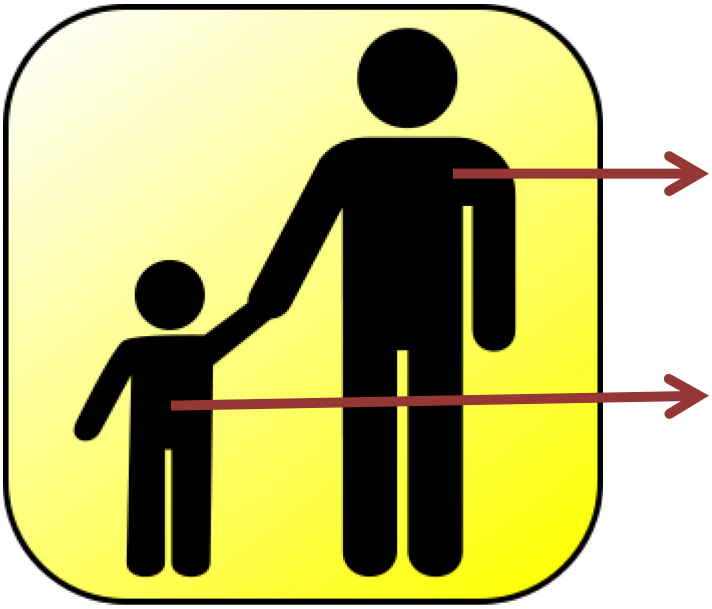
Tutorial: How do changes in body weight, intake rate and concentration impact dose?

Body weight: Two individuals weighing 35 kg and 70 kg consume 4 glasses of water in a day (0.250 L * 4 glasses=1 L) containing arsenic at 0.070 mg/L. Thus, each of them consumes the same amount of arsenic (0.070 mg/L x 1 L=0.070 mg). Yet on a mg/kg body weight basis, the person weighing 35 kg consumes twice as much arsenic as the person weighing 70 kg (i.e 0.070 mg ÷ 35 kg=0.002 mg/kg body weight/day or 2 µg/kg body weight/day versus 0.070 ÷70 kg=0.001 mg/kg body weight/day or 1 µg/kg body weight/day).



Weight of Adult=70 kg

Arsenic Concentration=0.070 mg/L

Intake Rate=1 L/Day

Dose=1 µg/kg body weight/day

Weight of Child=35 kg

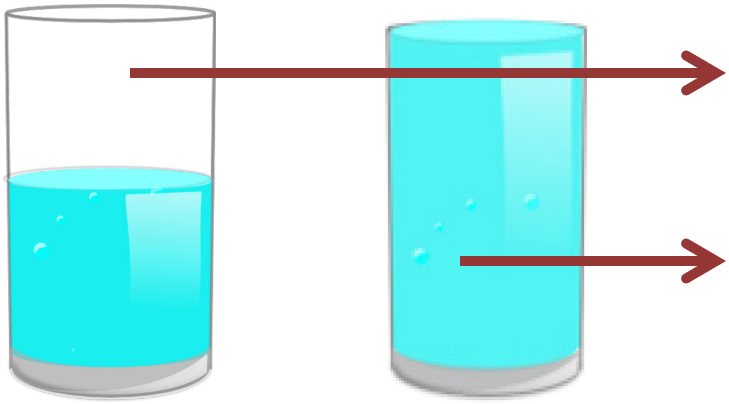
Arsenic Concentration=0.070 mg/L

Intake Rate=1 L/Day

Dose=2 µg/kg body weight/day

Doubling the body weight halves the mg/kg body weight dose

<u>Intake Rate</u>: Two 70 kg individuals consume water containing arsenic at 0.070 mg/L. One individual consumes 1 L of water in a day, while the other consumes 2 L in a day. The individual consuming the 2 L of water consumes twice as much arsenic as the individual consuming only 1 L, assuming all the arsenic is coming only from the water and that the arsenic is uniformly distributed in the water. (0.070 mg/L x 1 L=0.070 mg for 1 L and 0.070 mg/L x 2 L=0.140 mg for 2 L). This is reflected in the higher mg/kg body weight dose for the person consuming 2 L of water (i.e. 0.140 mg ÷ 70 kg=0.002 mg/kg body weight/day versus 0.070 mg ÷ 70 kg=0.001 mg/kg body weight/day.



Weight of Adult=70 kg

Arsenic Concentration=0.070 mg/L

Intake Rate=1 L/Day

Dose=1 µg/kg body weight/day

Weight of Adult=70 kg

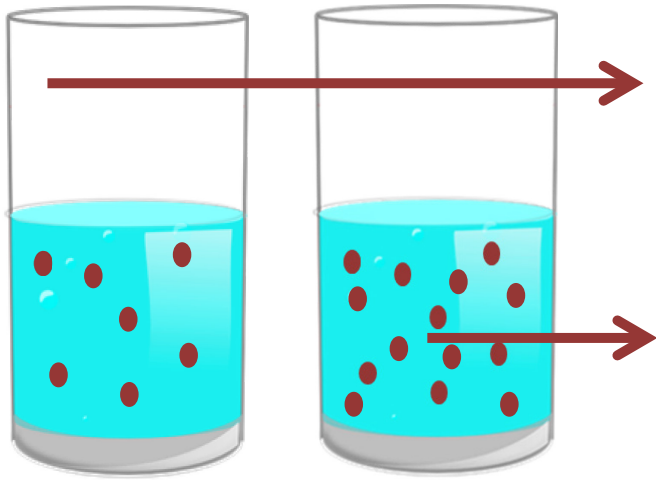
Arsenic Concentration=0.070 mg/L

Intake Rate=2 L/Day

Dose=2 µg/kg body weight/day

<u>Doubling intake rate doubles the mg/kg body weight dose</u>

Concentration: Two 70 kg individuals consume 1 L of water containing arsenic in a day. The concentration of arsenic in the water consumed by Person 1 is 0.070 mg/L while the concentration of arsenic consumed by person 2 is 0.140 mg/L. The individual consuming the water with twice the arsenic concentration consumed twice as much arsenic (0.070 mg/L x 1 L=0.070 mg for Person 1 and 0.140 mg/L x 1 L=0.140 mg for Person 2). This is reflected in the higher µg/kg body weight dose of the person drinking water containing the higher concentration of arsenic (i.e. 0.070 mg or 70 µg ÷ 70 kg=1 µg/kg body weight/day versus 0.140 mg or 140 µg ÷ 70 kg= 2 µg/kg body weight/day). Note that the effect of doubling concentration is the same as doubling intake rate on the mg/kg body weight dose.



Weight of Adult=70 kg

Arsenic Concentration=0.070 mg/L

Intake Rate=1 L/day

Dose=1 µg/kg body weight/day

Weight of Adult=70 kg

Arsenic Concentration=0.140 mg/L

Intake Rate=1 L/day

Dose=2 µg/kg body weight/day

Doubling the concentration doubles the mg/kg body weight dose