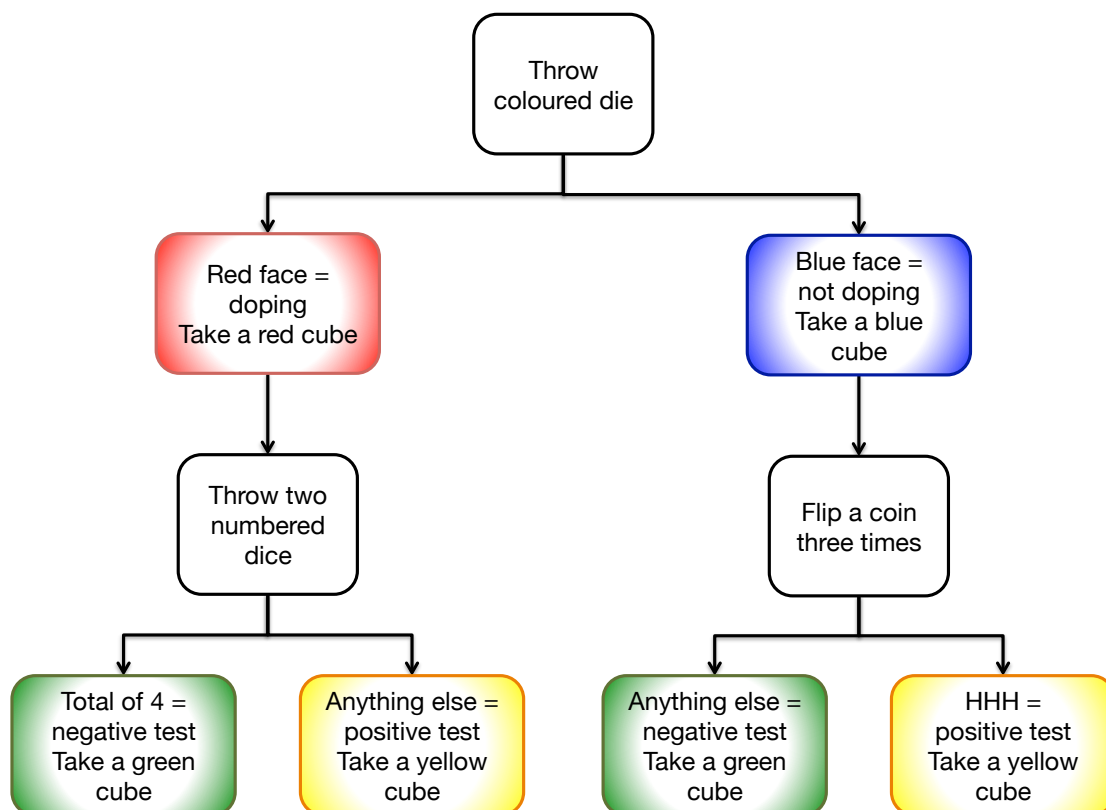# Who is cheating?

A new test is in development to try to identify athletes who use a certain banned substance to enhance their performance.

The test shows quite good results in detecting an athlete who has used this substance, but the false positive rate, ie. athletes who have not used it testing positive, is more worrying.

You are going to investigate the probability that an athlete who is not taking the substance is wrongly accused, and the probability that an athlete who is taking the substance is missed.

Carry out a series of 36 experiments, using the rules given in the flow chart - you should have 36 pairs of multi-link cubes when you finish.
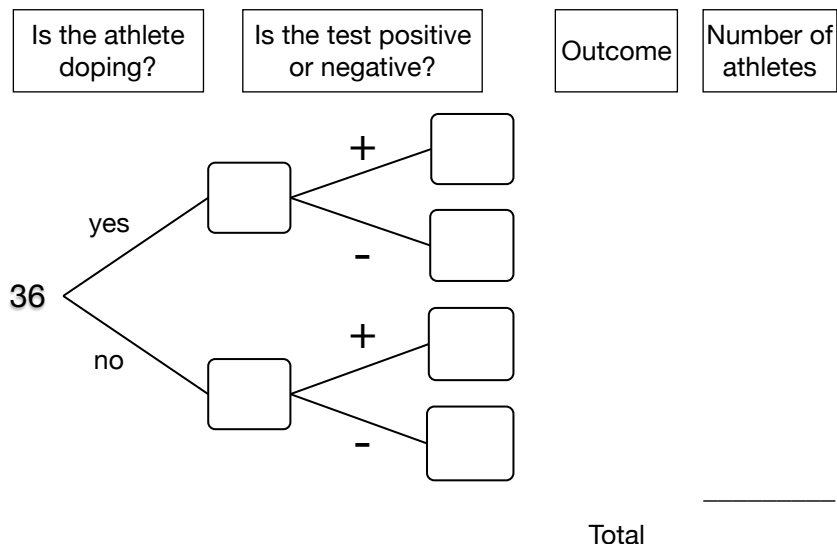
```
                         Throw
                       coloured die

        Red face =                          Blue face =
          doping                             not doping
       Take a red cube                      Take a blue
                                               cube

       Throw two                            Flip a coin
       numbered                             three times
         dice

Total of 4 =      Anything else =    Anything else =      HHH =
negative test     positive test      negative test     positive test
Take a green      Take a yellow      Take a green      Take a yellow
   cube               cube               cube               cube
```

What outcome does each of the following indicate:

• red/green

• red/yellow

• blue/green

• blue/yellow

Which outcomes indicate the test is not doing its job appropriately?

Which is the false positive? Which is the false negative?

Complete the tree diagram and 2-way table below for **your results for 36 athletes**.

Is the athlete doping?	Is the test positive or negative?	Outcome	Number of athletes

```
                              +  ┌──┐
                  ┌──┐           └──┘
           yes    │  │
                  └──┘        -  ┌──┐
                                 └──┘
      36
                              +  ┌──┐
           no     ┌──┐           └──┘
                  │  │
                  └──┘        -  ┌──┐
                                 └──┘
```
_____
Total

		Is the test positive or negative?		
		+	-	Total
Is the athlete doping?	Y			
	N			
Total				

1. Are there any surprises in your results? What makes them surprising?

    ....

    ....

    ....

For the following questions, give your answers as a fraction of 36.

For questions 4 and 5, you may find it helpful to complete the tables on the Hint Worksheet.

2. What proportion of the 36 trials involved:

    a) athletes who were doping, but tested negative

        ....

    b) athletes who were not doping but tested positive?

        ....

3. What proportion of the 36 athletes would you **expect** to be doping? Why?

    ....

    ....

4. What proportion of athletes **who are doping** would you **expect** to test **negative**? Why?

    ....

    ....

5. What proportion of athletes **who are not doping** would you **expect** to test positive? Why?

    ....

    ....

http://nrich.maths.org/9840