This problem concerns the area under the curve $y = \sqrt{1 - x^2}$ that forms half of the unit circle $x^2 + y^2 = 1$.

1. First, let's try to figure out the area that gives the definite integral $\int_0^{0.5} \sqrt{1 - x^2}\, dx$. Sketch this area and try to use geometry to calculate it. You should get an answer of the form $a + b\pi$, where a and b are constants that you must find. Some hints follow:

   - Split the area into two pieces: a triangle and a wedge of the unit circle (like a slice of pie) and calculate the two parts separately.
   - For the wedge of the circle, what proportion of the whole circle is it? You need the angle formed between the diagonal and the positive y-axis.
   - To determine the angle, remember your unit circle trig!

2. Now let's switch our focus to the area function $A(x) = \int_0^x \sqrt{1 - t^2}\, dt$. In a similar way to the work you did in (1), use geometry to find an expression for $A(x)$.

3. Check the Fundamental Theorem of Calculus (part 1) holds for your answer in (2).