Integral of Tangent

How do we integrate one of these trig functions if we can't work backward from a derivative we already know?

$$\int \tan x \, dx \quad = \quad \int \frac{\sin x}{\cos x} \, dx$$

If you're working an integral like this and you see a trig function, it's good to look around and see if you can also find the derivative of that trig function. We make the substitution:

$$u = \cos x, \quad du = -\sin x \, dx$$

and rewrite our integral as:

$$\int \tan x \, dx \quad = \quad \int \frac{\sin x \, dx}{\cos x}$$
$$= \quad \int \frac{-du}{u}$$
$$= \quad -\ln|u| + c$$
$$\int \tan x \, dx \quad = \quad -\ln|\cos(x)| + c$$

You'll find tables of formulas like this in the back of most textbooks. In addition, there is a certain amount of memorization that goes on in calculus; this is the kind of thing that you probably want to memorize.

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18.01SC Single Variable Calculus
Fall 2010

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