The uncertainties that affect the prediction of solar neutrino fluxes are evaluated with the aid of standard solar models. The uncertainties are determined from available data for all measured quantities that are known to affect significantly the neutrino fluxes; these include nuclear reaction rates, the solar constant, and the primordial surface composition of the sun. Uncertainties in theoretical quantities (such as the stellar opacity, the equation of state, and the rate of the proton-proton reaction) are estimated from the range of values in published state-of-the-art calculations. The uncertainty in each neutrino flux that is caused by a specified uncertainty in any of the parameters is evaluated with the aid of a series of standard solar models that were constructed for this purpose; the results are expressed in terms of the logarithmic partial derivative of each flux with respect to each parameter. The effects on the neutrino fluxes of changing individual parameters by large amounts can usually be estimated to satisfactory accuracy by making use of the tabulated partial derivatives. An overall "effective 3σ level of uncertainty" is defined using the requirement that the true value should lie within the estimated range unless someone has made a mistake. Effective 3σ levels of uncertainty, as well as best estimates, are determined for the following possible detectors of solar neutrinos: ^{2}H, ^{7}Li, ^{37}Cl, ^{71}Ga, ^{79}Br, ^{81}Br, ^{97}Mo, ^{98}Mo, ^{115}In, and electron-neutrino scattering. The most important sources of uncertainty in the predicted capture rates are identified and discussed for each detector separately. For the ^{37}Cl detector, the predicted capture rate is 7.6 ± 3.3 (effective 3σ errors) SNU. The measured production rate is (Cleveland, Davis, and Rowley, 1981) 2.1 ± 0.3 SNU (1σ error). For a ^{71}Ga detector, the expected capture rate is $106\,(1^{+0.12}_{-0.08})$ SNU (also effective 3σ errors). The relatively small uncertainty quoted for the ^{71}Ga detector is a direct result of the fact that ^{71}Ga is primarily sensitive to neutrinos from the basic proton-proton reaction, the rate of which is determined largely by the observed solar luminosity. The Caltech and Munster measured values for the cross-section factor for the reaction $^{3}\mathrm{He}(\alpha,\gamma)^{7}\mathrm{Be}$ are inconsistent with each other. The capture rates quoted above were obtained using the Caltech value for the cross-section factor. If the Munster value is used instead, then the predicted capture rate for the ^{37}Cl experiment is 4.95 ± 2.1 SNU (effective 3σ errors) and, for the ^{71}Ga experiment, 96.7 $(1^{+0.12}_{-0.08})$ SNU (effective 3σ errors). In order for the best-estimate value to agree with the observation of Davis (1978) of 2 SNU for the ^{37}Cl experiment, the cross-section factor $S_{34}(0)$ would have to be reduced by about 15σ to less than the Caltech value, i.e. to 7σ less than the Munster value. The characteristics of the standard solar model, constructed with the best available nuclear parameters, solar opacity, and equation of state, are presented in detail. The computational methods by which this and similar models were obtained are also described briefly. The primordial helium abundance inferred with the aid of standard solar models is $Y = 0.25 \pm 0.01$. The complementary relation between observations of solar neutrinos and of the normal modes of oscillation of the sun is examined. It is shown that the splitting of the observed large-n, small-l, p-mode (five minute) oscillations of the sun primarily originates in the outer ten percent of the solar mass, while the neutrinos from ^{8}B beta decay originate primarily in the inner five percent of the solar mass. The solar luminosity, and the flux of neutrinos from the proton-proton reaction, come mostly from an intermediate region.