Exponential Growth – Water Hyacinth

An ecological system is vulnerable to destruction from the introduction of plants or animals outside that system. For example, when a non-native plant is introduced into a new area, it usually does not have its growth checked by the environment. With unlimited food and no predators, the non-native plant grows exponentially, quickly covering, killing, and replacing the endemic, native, plants. Such a plant is the water hyacinth which has been called the worst aquatic plant in the world! It is native to South America, but is now a part of the lakes, rivers and streams in most of the southern United States.

The water hyacinth is said to have been introduced into the United States in Louisiana at the World's Industrial and Cotton Centennial Exposition of 1884-1885. A Floridian went home with water hyacinth plants and later released them into the St. Johns River. From this beginning, water hyacinths now cause problems such as forming impenetrable mats of floating vegetation. These block boat traffic, prevent swimming and fishing, and prevent sunlight and oxygen from getting into the water. Perhaps the worst effect of the water hyacinth is a reduction of biological diversity in waters which it inhabits.

Water hyacinths double in 6 to 18 days. For the purposes of this investigation, consider that the number of water hyacinths will double in 12 days. Also assume that there is unlimited food and that there are no predators. Suppose 4 water hyacinths were put into the St. John's River.

1. After 4 doubling periods, how many days will have elapsed?
2. After 96 days, there will have been how many doubling periods?
3. In 60 days, how many times will the water hyacinth population double? In 120 days?
4. Create a table that works through 10 doubling periods.

Days	Doubling Periods	Expressions	Total Hyacinths
0	0	$4 * 2^0$	4
12	1	$4 * 2^1$	8
24	2		
	Continue through 10		

5. Develop a formula to allow you to go directly from the number of days to the total hyacinths.
6. About how many days will it take for there to be more than a billion hyacinths from the original 4? How many years?
7. Using your formula, how many water hyacinths would there be after 3 years? (Ignore leap years)
8. Suppose growing conditions for water hyacinths were ideal and they doubled every 6 days. Rewrite your formula so that you start with the same four water hyacinths and double every 6 days.
9. Using the new formula, how many water hyacinths will there be after 3 years? (Still ignore leap years and justify your answer)
10. Do you think that the formula will accurately predict the total water hyacinths indefinitely, or are there environmental conditions which might limit it?