Some problems to discuss:

Every family has its own traditions. Some of them can be strange. This is particularly true around the holidays when people give gifts. Consider the following four families:

- Typical family: Everybody gives a gift to everybody else.
- Office family: If you want to exchange gifts in the office, but don’t want the expense of giving something for everybody, you can do the following: The name of each person in the family written on a piece of paper which is put into a hat. Each person in the family draws one name from the hat and gives a gift to that person.
- Prof. Hall’s family: (This is where it gets strange.) Each member of the family gives a gift to all the members of the family that “joined” (by birth or marriage) after them. So the great-great-grandfather gives a gift to everyone. The great-great-grandmother gives a gift to everyone except the great-great-grandfather, and so forth.
- Prof Snyder’s family: (He has a very enlightened family). Each generation of the family gets together and makes one gift to a charity in the name of the family. Suppose each generation is double the size of the previous generation.

Questions:
1.) Suppose each family has 14 members (that is, three generations of size 2, 4 and 8). How many gifts in total are given by all the members of each family?
2.) Suppose each family has 62 members (that is, five generations of size 2, 4, 8, 16 and 32). How many gifts in total are given by all the members of each family?
3.) Suppose each family has $N$ member. How many gifts in total are given by all the members of each family? (You may approximate to make this easier as necessary.)
4.) Think about how to give a proof (convincing argument) for your answer to question 3 other than just identifying the pattern.