

## **Big Bang Model Quick Notes**

### I. Protons and Neutrons Down to 1 Billion K and an Age of 100 seconds

*If you are a proton to start...have a positron (ping-pong ball in pocket)*

1. Move outward from the center of the group in a zigzag path.
2. If you touch before 1 Billion K, do not join.
3. If you touch after 1 Billion K, you can join or not join.
4. If you join with another proton, hold hands (or link arms) and:  
One emits a positron and holds up neutron sign.  
Other holds up proton and Deuterium (1 P + 1 N) sign.
5. But if you instead join with a neutron, hold hands (or link arms)  
And keep the P and N signs—hold up a Deuterium sign
6. Break apart if you wish as you bend or are bumped.
7. Rejoin as above when you wish.

*If you are a neutron to start...you do not have a positron.*

1. Move outward from the center of the group in a zigzag path.
2. If you touch before 1 Billion K, do not join.
3. If you touch a proton after 1 Billion K, you can join or not join.
4. If you join with a proton, hold up your neutron sign,  
One of you holds up the Deuterium (1 P and 1 N) sign.
5. Break apart if you wish as you bend or are bumped.
6. Rejoin as above when you wish.

*If you are in a deuterium*

1. If you meet another neutron, you may hold hands and hold  
up a Tritium (Hydrogen 3 with 1 P and 2 N) sign. You may also  
move away or break apart soon after you form.

## II. Deuterium, Protons, and Neutrons at Less than 1 Billion K and Older than 100 seconds

1. Continue to move outward.
2. If you are part of a Deuterium (1 P and 1 N) and you meet a proton, you may move apart or stick. If you stick, hold hands. Hide the Deuterium sign and hold up the Helium 3 sign.
3. If you are part of a Deuterium (1 P and 1 N) and you touch another Deuterium (1 P and 1 N) you can move away or join.  
If you join, hold hands, hide the Deuterium signs and hold up A Helium 4 sign.
4. If you are a Helium 3 and you meet a neutron and decide to join, Hide the Helium 3 and hold up a Helium 4 sign. (over)  
*(Also possible:*  
*-Helium 3 (2 P and 1 N) and Deuterium (1 P and 1 N) forms  
Helium 4 (2 P and 2 N) and a proton (one person leaves group).*  
*-Helium 3 (2 P and 1 N) + Deuterium (1 P and 1 N) forms  
Helium 4 (2 P and 2 N) and a neutron and a positron.)*

We're almost done...

5. Hopefully there is a Helium 3 (2 P and 1 N) and a Helium 4 (2 P and 2 N). When everyone freezes (no moving, no talking) we will try to find one each of these. These will hold hands to make Beryllium 7 (4 P and 3 N). The group holds up the Beryllium 7 sign. This nucleus is unstable; so one P emits a positron and holds an N sign. The group holds up the Lithium 7 sign.

Teacher calls “End.”