**How to Make a Laser Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. Light is emitted by a laser pointer and a flashlight. How do the photons differ? The laser photons
2. have more energy
3. are more focussed
4. are going in the same direction
5. all three are correct

Explain how you can demonstrate which answers are correct.

1. Open <https://phet.colorado.edu/en/simulation/lasers>. You are going to figure out how to make a laser. To start with, you want to get a single atom to emit light - any kind of light.
2. **Predict** what the settings on the lamp must be to get the atom to emit light and e**xplain** your reasoning behind these predictions.
3. **Observe** what happens and **explain** anything that was different from your predictions or in addition to them.

3) Sometimes the photons appear in pairs going in the same direction as the original photon. This is the result of **stimulated** **emission** rather than **spontaneous** **emission**.

1. **Predict** and **explain** what will happen if you reduce the lifetime of the excited level.
2. **Observe** and **explain** any differences or additions to your predictions.

4) Select the Multiple Atoms (Lasing) tab at the top. You now have many atoms and each atom has two energy levels. What colours can the atom emit?

A) red and blue B) red, blue and purple C) red, blue and ultraviolet D) red, blue and infrared

5) You are going to make a laser that emits a beam of red light.

a) You can adjust the lifetimes of the electronic energy levels. What should the setting on each be? Explain.

b) You can adjust the controls on the lamp. What should the intensity and colour be set to? Explain.

c) You can add mirrors (enable mirrors) to the right and left sides of the laser. How will the mirrors help?

d) The reflectivity of the mirror on the right can be adjusted so that some, all, or none of the light gets through. What should it be set to? Explain.

e) Why is light being sent into the tube at right angles to its length?

6) Stimulated emission is a quantum process.

a) There is no classical version of stimulated emission, but it has similarities to resonance and to chain reactions. Watch **32 Metronomes Demonstration of Resonance** <https://www.youtube.com/watch?v=_bJ1gNnlsfE> and **Mousetrap Fission** <https://www.youtube.com/watch?v=vjqIJW_Qr3c> what aspects of stimulated emission do these demonstrations match?

b) Watch **Minute Physics: How lasers work (in theory)** and explain how stimulated emission differs from spontaneous emission.

<https://www.youtube.com/watch?v=y3SBSbsdiYg&list=PLED25F943F8D6081C%20>

1. Watch Smarter Every Day 33: How lasers work (in practice) The previous video links to this.

 <http://bit.ly/uBwhU2>

7) The word laser comes from **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.

1. What is the difference between light and radiation in a laser?
2. Watch **Minute Physics: How lasers work (in theory)** and explain how stimulated emission differs from spontaneous emission. <https://www.youtube.com/watch?v=y3SBSbsdiYg&list=PLED25F943F8D6081C%20>
3. An amplifier in a music system adds energy to the signal making the resulting sound louder. How is amplification different in a laser?
4. The simulation showed a laser whose input power is from light. Most continuous lasers get their power from electricity. How are fluorescent light bulbs similar to and different from lasers?

8) When lasers were first produced they were described as a solution looking for a problem. Describe one use for a low powered laser and one for a high powered laser. Explain how the laser light’s properties are an improvement over the tool that it has replaced.