Name: _____ Date: _____ Period: _____

NOVA: Hunting the Elements

Part 1: Basic Chemistry

Blank Periodic Table

Fill in the parts of this periodic table covered by the documentary.

hydrogen 1 H 1.0079																	helium 2 He 4.0026
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305											aluminium 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29
caesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 *	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]
francium 87 Fr [223]	radium 88 Ra [226]	89-102 **	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	ununnilium 110 Uun [271]	unununium 111 Uuu [272]	ununbium 112 Uub [277]		ununquadium 114 Uuq [289]				

*Lanthanide series	lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
**Actinide series	actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

Gold - Au

1. Write the number of subatomic particles in gold:
    a. Protons:
    b. Neutrons:
    c. Electrons:
2. Give one property of gold.

3. How much gold is in one ton of the mined rock?

4. How much is each truckload of ore worth, once the gold is extracted?

5. What determines how reactive an element is?

6. Write and color code the noble metals on the blank periodic table.

7. Why is gold so heavy?

Copper - Cu

8. Write the number of subatomic particles in copper:
    a. Protons:
    b. Neutrons:
    c. Electrons:
9. List three uses of copper.

10. Give one property of copper.

The Alloy

11. What alloy does tin make when mixed with copper?

12. How are atoms arranged in pure metals?

13. Why isn't pure copper used for bells instead of bronze?

Electron Microscope

14. How much would you have to zoom in on a map of the United States to replicate the power of an electron microscope?

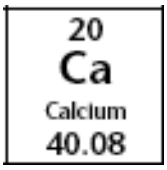
15. Why is the microscope wrapped in acoustic blankets?

16. What part of the atom is actually visible under the microscope?

17. What do protons determine about an element?

18. What is the number of protons called?

19. Label the atomic number, symbol, and atomic mass of calcium below:



20. Give an example of a real-life object made from each of the following elements:

    a. Calcium –

    b. Bismuth –

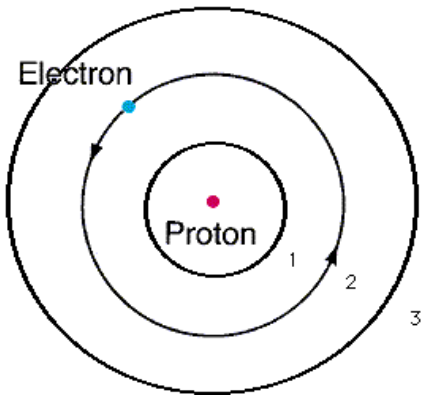
    c. Bromine –

21. What is a family of elements?

22. Where did the noble gases get their name?

23. What do electrons determine?

24. How many electrons can fill each of the orbital levels in the diagram below?



Chlorine - Cl

25. Give the number of atomic particles in chlorine:

    a. Protons –

    b. Neutrons –

    c. Electrons –

26. Chlorine wants to (take / give away) one electron, becoming an (ion / isotope).

27. Why do alkali metals and halogens react so strongly with other elements?

28. What do sodium and chlorine make when combined?

29. Compare the properties of each of the following:

	Sodium (Na)	**Chlorine (Cl)**	**Sodium Chloride (NaCl)**
State of Matter			
Reactive or Stable			
Practical Use			

Oxygen - O

30. What is ANFO?

31. What do each of the spikes on the ion chromatograph represent?

32. This is the chemical reaction of the ANFO explosion. Explain what happens during this reaction to release so much heat energy.

$$C + NH_4NO_3 - H_2O + N_2 + O_2$$

33. Write the chemical equation for the burning candle.

34. Write the chemical equation for the formation of rust.

35. Compare the speed and explosive force of gunpowder, emulsion-gel, and C4. Which is the fastest? Explain why.

NOVA: Hunting the Elements

Part 2: Chemistry of Life, Rare Earth Elements, and Radioactivity

Elements of Life

1. List the six most common elements of life, a common object they are found in, and an important property.

Element Symbol	Element Name	Common Object	Important Property
C			
H			
N			
O			
P			
S			

2. What can happen when excessive trace elements are lost from the body?

3. Describe a body function or part that utilizes each of these trace elements:

   a. Calcium –

   b. Iron –

   c. Potassium –

   d. Zinc –

   e. Magnesium –

   f. Sodium –

4. What conditions did the earliest bacteria need for energy production?

5. What do cyanobacteria use for energy production? What do they release as waste?

6. In the core sample collected from Yellowstone, which layer is the cyanobacteria?

Origin of the Elements

7. What is the origin of hydrogen, the smallest element?

8. Describe the process of fusion and how it produces helium.

9. What happens when a star runs low on hydrogen fuel?

10. What is created in supernova explosion?

Silicon and Glass

11. What elements is sand made of?

12. What is added to Gorilla Glass to make it stronger than normal glass?

Rare Earth Elements

13. Where do most of the rare earth elements come from?

14. How are the fifteen rare earth elements chemically similar?

15. What elements are rare earth magnets usually made of?

16. Why are rare earth elements in such short supply?

17. How do sharks react to rare earth metals?

18. Describe the following parts of the lemon shark experiment:

    Independent Variable –

    Dependent Variable –

    Experimental Group –

    Control Group –

Carbon Isotopes

19. What is the difference between the compositions of these carbon isotopes?

	Protons	**Electrons**	**Neutrons**
Carbon-12			
Carbon-13			
Carbon-14			

20. What happens to Carbon-14 over time?

21. Define radioactive half-life:

22. Based on carbon dating, how long ago did the tree die?

Nuclear Radiation

23. Give the number of subatomic particles in uranium:

    a. Protons –

    b. Neutrons –

    c. Electrons –

24. How is the mousetrap simulation similar to a fission chain reaction?

25. What element was used as fuel for the "Little Boy" bomb?

26. What element was used as fuel for the "Fat Man" bomb?

27. The scientists at Lawrence Livermore Lab have been able to produce 6 new, synthetic elements. Why isn't there yet a practical use for these elements?