

# TNReady High School End-of-Course Science

This document provides information about the design of the TNReady assessment. It is not intended to be used solely as an instructional resource or as pacing guide. Districts should consult the Tennessee academic standards when making all instructional decisions including scope and sequence. The Tennessee academic standards can be found [here](#).

## High School EOC Testing Structure in Biology I and Chemistry I

As in the past, each year the state assessment includes both operational and field test items. The below testing structure for science reflects both the number of operational assessment items and the number of field test assessment items.

Test Design	
Biology I	<ul style="list-style-type: none"> <li>• 75 minutes</li> <li>• 60 items</li> </ul>
Chemistry I	<ul style="list-style-type: none"> <li>• 75 minutes</li> <li>• 60 items</li> </ul>

## High School EOC Blueprints in Biology I and Chemistry I

The blueprints below reflect *only* operational assessment items. You can find both the Biology I and Chemistry I standards [here](#).

Biology			
	# of Items	# of Score Points	% of Test
<b>Content</b>			
• Inquiry and Technology & Engineering	5-10	5-10	9-18
• Cells	11-13	11-13	20-24
• Interdependence	6-7	6-7	11-13
• Flow of Matter and Energy	9-10	9-10	16-18
• Heredity	11-14	11-14	20-25
• Biodiversity & Change	6-7	6-7	11-13
<b>TOTAL</b>	50	50	100
Chemistr			
	# of Items	# of Score Points	% of Test
<b>Content</b>			
• Inquiry and Technology & Engineering	8-10	8-10	14-18
• Atomic Structure	9-11	9-11	16-20
• Matter and Energy	14-16	14-16	25-29
• Interactions of Matter	20-22	20-22	36-40
<b>TOTAL</b>	50	50	100

# Calculator Guidance for Science End-of-Course Assessments

## Biology

The TNReady End-of-Course biology assessment does not require the use of a calculator. Tennessee science standards for this course do not have a mathematical component, and therefore students are not permitted to use a calculator. It is unnecessary for IEP teams to recommend the use of calculators for students in this course.

## Chemistry

The TNReady End-of-Course chemistry assessment requires the use of a calculator for all students. Tennessee science standards for this course have a very strong mathematical component, and therefore all students will need to have a calculator in order to complete the assessment. Please refer to the TNReady High School Mathematics Calculator Policy for a list of permissible calculators.

## Item Types

**Multiple choice:** These are items with four answer options, only one of which is correct.

**Multiple select:** These are items with more than four answer choices with multiple correct answers. Sometimes the number of correct responses will be indicated (e.g., “choose the three correct answers”), but sometimes the number of correct responses will not be indicated (e.g., “select all of the correct answers”). These items are dependent and based on the standard. For 2017-18, these items will be field tested only in science.

# Chemistry Reference Sheet

		Periodic Table of the Elements																		
		Key																		
		Atomic Number																		
		Element Symbol																		
		Element Name																		
		Average Atomic Mass *																		
1	1	<b>H</b> Hydrogen 1.008	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
2	3	<b>Li</b> Lithium 6.941	4	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
3	11	<b>Na</b> Sodium 22.990	12	<b>Mg</b> Magnesium 24.305	13	<b>Al</b> Aluminum 26.982	14	<b>Si</b> Silicon 28.086	15	<b>P</b> Phosphorus 30.974	16	<b>S</b> Sulfur 32.066	17	<b>Cl</b> Chlorine 35.453	18	<b>Ar</b> Argon 39.948	19	<b>K</b> Potassium 39.098	20	<b>Ca</b> Calcium 40.078
4	37	<b>Rb</b> Rubidium 85.468	38	<b>Sr</b> Strontium 87.620	39	<b>Y</b> Yttrium 88.906	40	<b>Zr</b> Zirconium 91.224	41	<b>Nb</b> Niobium 92.906	42	<b>Mo</b> Molybdenum 95.940	43	<b>Tc</b> Technetium (98)	44	<b>Ru</b> Ruthenium 101.070	45	<b>Rh</b> Rhodium 102.906	46	<b>Pd</b> Palladium 106.420
5	55	<b>Cs</b> Cesium 132.905	56	<b>Ba</b> Barium 137.327	57	<b>La</b> Lanthanum 138.905	58	<b>Ce</b> Cerium 140.12	59	<b>Pr</b> Praseodymium 140.907	60	<b>Nd</b> Neodymium 144.24	61	<b>Pm</b> Promethium (144.9128)	62	<b>Sm</b> Samarium 150.36	63	<b>Eu</b> Europium 151.964	64	<b>Gd</b> Gadolinium 157.25
6	87	<b>Fr</b> Francium (223)	88	<b>Ra</b> Radium (226)	89	<b>Ac</b> Actinium (227)	90	<b>Th</b> Thorium 232.0377	91	<b>Pa</b> Protactinium 231.03688	92	<b>U</b> Uranium 238.02891	93	<b>Np</b> Neptunium (237.048173)	94	<b>Pu</b> Plutonium (244)	95	<b>Am</b> Americium (243)	96	<b>Cm</b> Curium (247)
7	113	<b>In</b> Indium 114.818	114	<b>Sn</b> Tin 118.710	115	<b>Sb</b> Antimony 121.760	116	<b>Te</b> Tellurium 127.60	117	<b>I</b> Iodine 126.904	118	<b>Xe</b> Xenon 131.29	119	<b>At</b> Astatine (210)	120	<b>Rn</b> Radon (222)	121	<b>Uu</b> Ununium (289)	122	<b>Uu</b> Ununium (289)
	127	<b>Ag</b> Silver 107.868	128	<b>Cd</b> Cadmium 112.411	129	<b>In</b> Indium 114.818	130	<b>Hg</b> Mercury 200.590	131	<b>Tl</b> Thallium 204.383	132	<b>Pb</b> Lead 207.200	133	<b>Bi</b> Bismuth 208.980	134	<b>Po</b> Polonium (209)	135	<b>At</b> Astatine (210)	136	<b>Rn</b> Radon (222)
	147	<b>Fr</b> Francium (223)	148	<b>Ra</b> Radium (226)	149	<b>Ac</b> Actinium (227)	150	<b>Th</b> Thorium (232)	151	<b>Pa</b> Protactinium (231)	152	<b>U</b> Uranium (238)	153	<b>Np</b> Neptunium (237)	154	<b>Pu</b> Plutonium (244)	155	<b>Am</b> Americium (243)	156	<b>Cm</b> Curium (247)
	173	<b>Lu</b> Lutetium 174.967	174	<b>Hf</b> Hafnium 178.49	175	<b>Ta</b> Tantalum 180.948	176	<b>W</b> Tungsten 183.84	177	<b>Re</b> Rhenium 186.207	178	<b>Os</b> Osmium 190.230	179	<b>Ir</b> Iridium 192.22	180	<b>Pt</b> Platinum 195.084	181	<b>Au</b> Gold 196.967	182	<b>Hg</b> Mercury 200.590
	188	<b>Er</b> Erbium 187.48	189	<b>Tm</b> Thulium 188.906	190	<b>Yb</b> Ytterbium 190.48	191	<b>Lu</b> Lutetium 190.48	192	<b>Hf</b> Hafnium 178.49	193	<b>Ta</b> Tantalum 180.948	194	<b>W</b> Tungsten 183.84	195	<b>Re</b> Rhenium 186.207	196	<b>Os</b> Osmium 190.230	197	<b>Ir</b> Iridium 192.22
	201	<b>Tl</b> Thallium 204.383	202	<b>Pb</b> Lead 207.200	203	<b>Bi</b> Bismuth 208.980	204	<b>Po</b> Polonium (209)	205	<b>At</b> Astatine (210)	206	<b>Rn</b> Radon (222)	207	<b>Uu</b> Ununium (289)	208	<b>Uu</b> Ununium (289)	209	<b>Uu</b> Ununium (289)	210	<b>Uu</b> Ununium (289)
	217	<b>Lu</b> Lutetium 174.967	218	<b>Hf</b> Hafnium 178.49	219	<b>Ta</b> Tantalum 180.948	220	<b>W</b> Tungsten 183.84	221	<b>Re</b> Rhenium 186.207	222	<b>Os</b> Osmium 190.230	223	<b>Ir</b> Iridium 192.22	224	<b>Pt</b> Platinum 195.084	225	<b>Au</b> Gold 196.967	226	<b>Hg</b> Mercury 200.590
	232	<b>U</b> Uranium 238.02891	233	<b>Np</b> Neptunium (237.048173)	234	<b>Pu</b> Plutonium (244)	235	<b>Am</b> Americium (243)	236	<b>Cm</b> Curium (247)	237	<b>Bk</b> Berkelium (247)	238	<b>Cf</b> Californium (251)	239	<b>Es</b> Einsteinium (252)	240	<b>Fm</b> Fermium (253)	241	<b>Mn</b> Mendelevium (258)
	250	<b>U</b> Uranium 238.02891	251	<b>Np</b> Neptunium (237.048173)	252	<b>Pu</b> Plutonium (244)	253	<b>Am</b> Americium (243)	254	<b>Cm</b> Curium (247)	255	<b>Bk</b> Berkelium (247)	256	<b>Cf</b> Californium (251)	257	<b>Es</b> Einsteinium (252)	258	<b>Fm</b> Fermium (253)	259	<b>Mn</b> Mendelevium (258)
	269	<b>U</b> Uranium 238.02891	270	<b>Np</b> Neptunium (237.048173)	271	<b>Pu</b> Plutonium (244)	272	<b>Am</b> Americium (243)	273	<b>Cm</b> Curium (247)	274	<b>Bk</b> Berkelium (247)	275	<b>Cf</b> Californium (251)	276	<b>Es</b> Einsteinium (252)	277	<b>Fm</b> Fermium (253)	278	<b>Mn</b> Mendelevium (258)
	289	<b>U</b> Uranium 238.02891	290	<b>Np</b> Neptunium (237.048173)	291	<b>Pu</b> Plutonium (244)	292	<b>Am</b> Americium (243)	293	<b>Cm</b> Curium (247)	294	<b>Bk</b> Berkelium (247)	295	<b>Cf</b> Californium (251)	296	<b>Es</b> Einsteinium (252)	297	<b>Fm</b> Fermium (253)	298	<b>Mn</b> Mendelevium (258)
	303	<b>U</b> Uranium 238.02891	304	<b>Np</b> Neptunium (237.048173)	305	<b>Pu</b> Plutonium (244)	306	<b>Am</b> Americium (243)	307	<b>Cm</b> Curium (247)	308	<b>Bk</b> Berkelium (247)	309	<b>Cf</b> Californium (251)	310	<b>Es</b> Einsteinium (252)	311	<b>Fm</b> Fermium (253)	312	<b>Mn</b> Mendelevium (258)
	315	<b>U</b> Uranium 238.02891	316	<b>Np</b> Neptunium (237.048173)	317	<b>Pu</b> Plutonium (244)	318	<b>Am</b> Americium (243)	319	<b>Cm</b> Curium (247)	320	<b>Bk</b> Berkelium (247)	321	<b>Cf</b> Californium (251)	322	<b>Es</b> Einsteinium (252)	323	<b>Fm</b> Fermium (253)	324	<b>Mn</b> Mendelevium (258)
	327	<b>U</b> Uranium 238.02891	328	<b>Np</b> Neptunium (237.048173)	329	<b>Pu</b> Plutonium (244)	330	<b>Am</b> Americium (243)	331	<b>Cm</b> Curium (247)	332	<b>Bk</b> Berkelium (247)	333	<b>Cf</b> Californium (251)	334	<b>Es</b> Einsteinium (252)	335	<b>Fm</b> Fermium (253)	336	<b>Mn</b> Mendelevium (258)
	343	<b>U</b> Uranium 238.02891	344	<b>Np</b> Neptunium (237.048173)	345	<b>Pu</b> Plutonium (244)	346	<b>Am</b> Americium (243)	347	<b>Cm</b> Curium (247)	348	<b>Bk</b> Berkelium (247)	349	<b>Cf</b> Californium (251)	350	<b>Es</b> Einsteinium (252)	351	<b>Fm</b> Fermium (253)	352	<b>Mn</b> Mendelevium (258)
	355	<b>U</b> Uranium 238.02891	356	<b>Np</b> Neptunium (237.048173)	357	<b>Pu</b> Plutonium (244)	358	<b>Am</b> Americium (243)	359	<b>Cm</b> Curium (247)	360	<b>Bk</b> Berkelium (247)	361	<b>Cf</b> Californium (251)	362	<b>Es</b> Einsteinium (252)	363	<b>Fm</b> Fermium (253)	364	<b>Mn</b> Mendelevium (258)
	369	<b>U</b> Uranium 238.02891	370	<b>Np</b> Neptunium (237.048173)	371	<b>Pu</b> Plutonium (244)	372	<b>Am</b> Americium (243)	373	<b>Cm</b> Curium (247)	374	<b>Bk</b> Berkelium (247)	375	<b>Cf</b> Californium (251)	376	<b>Es</b> Einsteinium (252)	377	<b>Fm</b> Fermium (253)	378	<b>Mn</b> Mendelevium (258)
	383	<b>U</b> Uranium 238.02891	384	<b>Np</b> Neptunium (237.048173)	385	<b>Pu</b> Plutonium (244)	386	<b>Am</b> Americium (243)	387	<b>Cm</b> Curium (247)	388	<b>Bk</b> Berkelium (247)	389	<b>Cf</b> Californium (251)	390	<b>Es</b> Einsteinium (252)	391	<b>Fm</b> Fermium (253)	392	<b>Mn</b> Mendelevium (258)
	397	<b>U</b> Uranium 238.02891	398	<b>Np</b> Neptunium (237.048173)	399	<b>Pu</b> Plutonium (244)	400	<b>Am</b> Americium (243)	401	<b>Cm</b> Curium (247)	402	<b>Bk</b> Berkelium (247)	403	<b>Cf</b> Californium (251)	404	<b>Es</b> Einsteinium (252)	405	<b>Fm</b> Fermium (253)	406	<b>Mn</b> Mendelevium (258)
	409	<b>U</b> Uranium 238.02891	410	<b>Np</b> Neptunium (237.048173)	411	<b>Pu</b> Plutonium (244)	412	<b>Am</b> Americium (243)	413	<b>Cm</b> Curium (247)	414	<b>Bk</b> Berkelium (247)	415	<b>Cf</b> Californium (251)	416	<b>Es</b> Einsteinium (252)	417	<b>Fm</b> Fermium (253)	418	<b>Mn</b> Mendelevium (258)
	421	<b>U</b> Uranium 238.02891	422	<b>Np</b> Neptunium (237.048173)	423	<b>Pu</b> Plutonium (244)	424	<b>Am</b> Americium (243)	425	<b>Cm</b> Curium (247)	426	<b>Bk</b> Berkelium (247)	427	<b>Cf</b> Californium (251)	428	<b>Es</b> Einsteinium (252)	429	<b>Fm</b> Fermium (253)	430	<b>Mn</b> Mendelevium (258)
	435	<b>U</b> Uranium 238.02891	436	<b>Np</b> Neptunium (237.048173)	437	<b>Pu</b> Plutonium (244)	438	<b>Am</b> Americium (243)	439	<b>Cm</b> Curium (247)	440	<b>Bk</b> Berkelium (247)	441	<b>Cf</b> Californium (251)	442	<b>Es</b> Einsteinium (252)	443	<b>Fm</b> Fermium (253)	444	<b>Mn</b> Mendelevium (258)
	449	<b>U</b> Uranium 238.02891	450	<b>Np</b> Neptunium (237.048173)	451	<b>Pu</b> Plutonium (244)	452	<b>Am</b> Americium (243)	453	<b>Cm</b> Curium (247)	454	<b>Bk</b> Berkelium (247)	455	<b>Cf</b> Californium (251)	456	<b>Es</b> Einsteinium (252)	457	<b>Fm</b> Fermium (253)	458	<b>Mn</b> Mendelevium (258)
	463	<b>U</b> Uranium 238.02891	464	<b>Np</b> Neptunium (237.048173)	465	<b>Pu</b> Plutonium (244)	466	<b>Am</b> Americium (243)	467	<b>Cm</b> Curium (247)	468	<b>Bk</b> Berkelium (247)	469	<b>Cf</b> Californium (251)	470	<b>Es</b> Einsteinium (252)	471	<b>Fm</b> Fermium (253)	472	<b>Mn</b> Mendelevium (258)
	477	<b>U</b> Uranium 238.02891	478	<b>Np</b> Neptunium (237.048173)	479	<b>Pu</b> Plutonium (244)	480	<b>Am</b> Americium (243)	481	<b>Cm</b> Curium (247)	482	<b>Bk</b> Berkelium (247)	483	<b>Cf</b> Californium (251)	484	<b>Es</b> Einsteinium (252)	485	<b>Fm</b> Fermium (253)	486	<b>Mn</b> Mendelevium (258)
	491	<b>U</b> Uranium 238.02891	492	<b>Np</b> Neptunium (237.048173)	493	<b>Pu</b> Plutonium (244)	494	<b>Am</b> Americium (243)	495	<b>Cm</b> Curium (247)	496	<b>Bk</b> Berkelium (247)	497	<b>Cf</b> Californium (251)	498	<b>Es</b> Einsteinium (252)	499	<b>Fm</b> Fermium (253)	500	<b>Mn</b> Mendelevium (258)
	505	<b>U</b> Uranium 238.02891	506	<b>Np</b> Neptunium (237.048173)	507	<b>Pu</b> Plutonium (244)	508	<b>Am</b> Americium (243)	509	<b>Cm</b> Curium (247)	510	<b>Bk</b> Berkelium (247)	511	<b>Cf</b> Californium (251)	512	<b>Es</b> Einsteinium (252)	513	<b>Fm</b> Fermium (253)	514	<b>Mn</b> Mendelevium (258)
	519	<b>U</b> Uranium 238.02891	520	<b>Np</b> Neptunium (237.048173)	521	<b>Pu</b> Plutonium (244)	522	<b>Am</b> Americium (243)	523	<b>Cm</b> Curium (247)	524	<b>Bk</b> Berkelium (247)	525	<b>Cf</b> Californium (251)	526	<b>Es</b> Einsteinium (252)	527	<b>Fm</b> Fermium (253)	528	<b>Mn</b> Mendelevium (258)
	533	<b>U</b> Uranium 238.02891	534	<b>Np</b> Neptunium (237.048173)	535	<b>Pu</b> Plutonium (244)	536	<b>Am</b> Americium (243)	537	<b>Cm</b> Curium (247)	538	<b>Bk</b> Berkelium (247)	539	<b>Cf</b> Californium (251)	540	<b>Es</b> Einsteinium (252)	541	<b>Fm</b> Fermium (253)	542	<b>Mn</b> Mendelevium (258)
	547	<b>U</b> Uranium 238.02891	548	<b>Np</b> Neptunium (237.048173)	549	<b>Pu</b> Plutonium (244)	550	<b>Am</b> Americium (243)	551	<b>Cm</b> Curium (247)	552	<b>Bk</b> Berkelium (247)	553	<b>Cf</b> Californium (251)	554	<b>Es</b> Einsteinium (252)	555	<b>Fm</b> Fermium (253)	556	<b>Mn</b> Mendelevium (258)
	561	<b>U</b> Uranium 238.02																		

## Chemistry Reference Page

### Formulas, Constants, and Unit Conversions

Formulas	
Change in Enthalpy (Heat): $Q = m(\Delta T)c_p$	Heat of Fusion: $Q = m\Delta H_{fus}$
Ideal Gas Law: $PV = nRT$	Heat of Vaporization: $Q = m\Delta H_{vap}$
Density: $d = \frac{m}{V}$	Molarity ( $M$ ) = $\frac{\text{mol of solute}}{\text{L of solution}}$
Combined Gas Law: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	Molality ( $m$ ) = $\frac{\text{mol of solute}}{\text{kg of solvent}}$
Boiling Point Elevation: $\Delta T_b = k_b \times m$	Freezing Point Depression: $\Delta T_f = k_f \times m$

Constants	
Universal Gas Constant (R): $0.0821 \frac{\text{atm} \times \text{L}}{\text{mol} \times \text{K}}$ , or equal to $8.31 \frac{\text{kPa} \times \text{L}}{\text{mol} \times \text{K}}$	
Molar Volume at STP: $22.4 \frac{\text{L}}{\text{mol}}$	Avogadro's Number (1 mole): $6.02 \times 10^{23}$
Specific Heat Capacity of Liquid Water: $c_p (\text{H}_2\text{O}) = 1.00 \frac{\text{cal}}{\text{g} \times ^\circ\text{C}} = 4.18 \frac{\text{J}}{\text{g} \times ^\circ\text{C}}$	

Unit Conversions	
1 atm = 760 mm Hg = 760 Torr = 101.3 kPa = $14.7 \frac{\text{lb}}{\text{in}^2} = 29.92 \text{ in. Hg}$	K = °C + 273
1.000 calorie = 4.184 Joules	1 mL = 1 cm <sup>3</sup> 1 L = 1,000 mL = 1,000 cm <sup>3</sup>
giga (G) = 10 <sup>9</sup> , mega (M) = 10 <sup>6</sup> , kilo (k) = 10 <sup>3</sup> , hecto (h) = 10 <sup>2</sup> , deka (da) = 10 <sup>1</sup>	
deci (d) = 10 <sup>-1</sup> , centi (c) = 10 <sup>-2</sup> , milli (m) = 10 <sup>-3</sup> , micro (μ) = 10 <sup>-6</sup> , nano (n) = 10 <sup>-9</sup>	

Common Ions					
Element Name	Charges	Ions	Charges	Ions	Charges
Silver (Ag <sup>+</sup> )	1+	Ammonium (NH <sub>4</sub> <sup>+</sup> )	1+	Oxide (O <sup>2-</sup> )	2-
Zinc (Zn <sup>2+</sup> )	2+	Nitrate (NO <sub>3</sub> <sup>-</sup> )	1-	Sulfide (S <sup>2-</sup> )	2-
Scandium (Sc <sup>3+</sup> )	3+	Nitrite (NO <sub>2</sub> <sup>-</sup> )	1-	Sulfate (SO <sub>4</sub> <sup>2-</sup> )	2-
Copper (Cu <sup>1+</sup> , Cu <sup>2+</sup> )	1+, 2+	Hydrogen Carbonate (HCO <sub>3</sub> <sup>-</sup> )	1-	Sulfite (SO <sub>3</sub> <sup>2-</sup> )	2-
Gold (Au <sup>1+</sup> , Au <sup>3+</sup> )	1+, 3+	Perchlorate (ClO <sub>4</sub> <sup>-</sup> )	1-	Carbonate (CO <sub>3</sub> <sup>2-</sup> )	2-
Cobalt (Co <sup>2+</sup> , Co <sup>3+</sup> )	2+, 3+	Chlorate (ClO <sub>3</sub> <sup>-</sup> )	1-	Peroxide (O <sub>2</sub> <sup>2-</sup> )	2-
Nickel (Ni <sup>2+</sup> , Ni <sup>3+</sup> )	2+, 3+	Chlorite (ClO <sub>2</sub> <sup>-</sup> )	1-	Chromate (CrO <sub>4</sub> <sup>2-</sup> )	2-
Lead (Pb <sup>2+</sup> , Pb <sup>4+</sup> )	2+, 4+	Hypochlorite (ClO <sup>-</sup> )	1-	Dichromate (Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup> )	2-
Tin (Sn <sup>2+</sup> , Sn <sup>4+</sup> )	2+, 4+			Phosphate (PO <sub>4</sub> <sup>3-</sup> )	3-
Mercury (Hg <sup>1+</sup> , Hg <sup>2+</sup> )	1+, 2+				
Iron (Fe <sup>2+</sup> , Fe <sup>3+</sup> )	2+, 3+				
Titanium (Ti <sup>2+</sup> , Ti <sup>3+</sup> , Ti <sup>4+</sup> )	2+, 3+, 4+				
Chromium (Cr <sup>2+</sup> , Cr <sup>3+</sup> )	2+, 3+				
Vanadium (V <sup>2+</sup> , V <sup>3+</sup> , V <sup>4+</sup> )	2+, 3+, 4+				
Manganese (Mn <sup>2+</sup> , Mn <sup>3+</sup> , Mn <sup>4+</sup> )	2+, 3+, 4+				

Turn over for Periodic Table of the Elements