

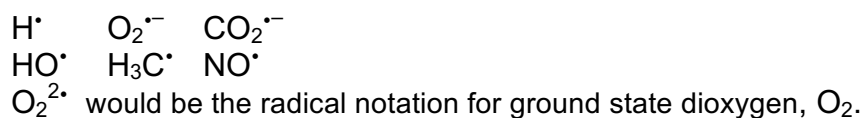
## Free Radical Nomenclature, Suggestions

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The purpose of this document is to provide an easy reference to some of the language of Redox Radical Biology. We provide here a beginning guideline to nomenclature and notation for free radicals and related redox species. The International Union of Pure and Applied Chemistry (IUPAC) does not provide suggestions on all abbreviations we might use; attached are the suggestions of the FRRB Program at The University of Iowa. Guidelines for nomenclature in Free Radical Biology can be found in [1, 2, 3, 4, 5 and references therein].

### I. Free Radical and Oxidant Notation and Nomenclature

In chemical formulae, as well as when using abbreviations, a free radical is denoted by a superscript dot to the right preceding any charge. This placement of the dot will not interfere with indication of mass number, atomic number, or composition.



**Table 1. Formulae and IUPAC Recommended Names of Simple Compounds Containing C, H, N, and O in Free Radical Biology**

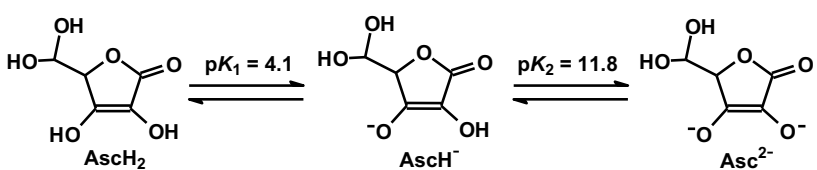
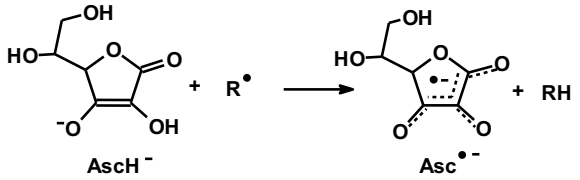
Species	Common Name	Systematic Name	Alternative and Comments
CO	carbon monoxide	carbon monoxide	oxidomethanediyl
CO <sub>2</sub>	carbon dioxide	carbon dioxide	dioxidomethane
CO <sub>2</sub> <sup>•-</sup>	carbon dioxide radical anion	dioxidocarbonate (•1-)	oxidooxomethyl radical
CO <sub>3</sub> <sup>•-</sup>	carbonate radical	trioxidocarbonate(•1-)	
H <sup>•</sup>	hydrogen atom	monohydrogen(•)	
H <sup>+</sup>	proton	hydron, monohydrogen(1+)	not to be confused with H <sup>•</sup>
H <sub>2</sub> O	water	dihydrogen monoxide	oxidane
H <sub>2</sub> O <sub>2</sub>	hydrogen peroxide	dihydriddioxide	dioxidane
H <sub>3</sub> C <sup>•</sup>	methyl radical		
HNO	nitroxyl	nitrosyl hydride	
HNO <sub>2</sub>	nitrous acid		
HNO <sub>3</sub>	nitric acid		

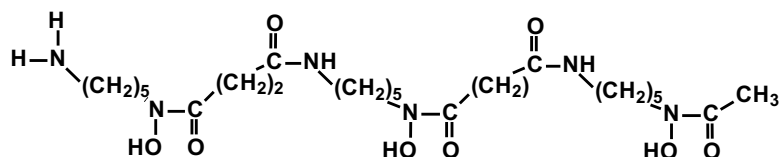
HO <sup>•</sup>	hydroxyl radical	hydridooxygen(•)	oxidanyl
HO <sub>2</sub> <sup>-</sup>		hydridodioxygen (1-)	dioxidanide, hydrogendioxide(1-); hydrogenperoxide(1-); hydroperoxide is not recommended
HO <sub>2</sub> <sup>•</sup>	hydroperoxyl, but is obsolete	hydridodioxygen(•)	dioxidonyl, hydrodioxyl, perhydroxyl does not make sense
HO <sub>3</sub> <sup>•</sup>	hydrogen trioxide radical	hydridotrioxxygen(•)	trioxidanyl
HOCO <sup>•</sup>		hydroxidooxidocarbon(•)	Protonated carbon dioxide radical
HOCO <sup>•</sup> <sub>2</sub>		hydroxidodioxidocarbon(•)	Protonated carbonate radical
HOCO <sup>•</sup>		hydroxidooxidocarbon(•)	
HOCO <sup>•</sup> <sub>2</sub>		hydroxidodioxidocarbon(•)	
HOCl	hypochlorous acid	hydrogenoxidochlorate	
HOBr	hypobromous acid	hydrogenoxidobromate	
HOI	hypoiodous acid	hydrogenoxidiodate	
HOSCN	hypothiocyanous acid	hydrogenoxidothiocyanate	
HNO	nitroxyl, protonated form of NO <sup>-</sup>		See [6] for chemistry and NO <sup>-</sup>
HON <sup>2+</sup>		hydroxidonitrogen(2•)(triplet)	hydrogen oxidonitrate(2•)(triplet)
HOOCO <sup>•</sup>		(hydridodioxido)oxidocarbon(•)	
HOONO	peroxynitrous acid	hydrogenoxidoperoxidonitrate	nitrosodioxidane
H <sub>2</sub> S	hydrogen sulfide	dihydrogen sulfide	
HSNO	thionitrous acid		
(NO) <sub>2</sub> <sup>+•</sup>		<i>bis</i> (oxidonitrate)(N – N)(•1-)	
N <sub>2</sub> O	nitrous oxide	dinitrogen monoxide	
N <sub>2</sub> O <sup>-•</sup>		oxidodinitrate(•1-)	
N <sub>2</sub> O <sub>3</sub>	dinitrogen trioxide		
N <sub>3</sub> <sup>•</sup>	azidyl radical	trinitrogen(2N – N)(•)	
NO <sup>•</sup>	nitric oxide, but is obsolete	oxidonitrogen(•)	oxoazanyl, nitrogen monoxide
NO <sup>+</sup>	nitrosonium ion		
NO <sup>-</sup>	nitroxyl anion		conjugate base of HNO
NO <sup>(2•)-</sup>	Nitroxy ??	oxidonitrate(2•1-) (triplet)	
NO <sub>2</sub> <sup>-</sup>	nitrite	dioxidonitrate(1-)	
NO <sub>2</sub> <sup>•</sup>	nitrogen dioxide	dioxidonitrogen(•)	
NO <sub>2</sub> <sup>•2-</sup>		dioxidonitrate(•2-)	
NO <sub>3</sub> <sup>-</sup>	nitrate	trioxidonitrate(-)	
NO <sub>3</sub> <sup>•</sup>	nitrogen trioxide	trioxidonitrogen(•)	nitrosoxidanyl
NO <sub>3</sub> <sup>•2-</sup>		trioxidonitrate(•2-)	

$O^{\bullet-}$	radical anion of $HO^{\bullet}$	oxide( $\bullet 1-$ )	oxidanidyl
$O_2^{\bullet-}$	superoxide	dioxide( $\bullet 1-$ )	dioxidanidyl
$O_2^{\bullet+}$		dioxygen( $\bullet 1+$ )	
$O_2^{2\bullet}$	oxygen, usually written as $O_2$	dioxygen (triplet)	dioxidanediyl
$O_3$	ozone	trioxygen	
$O_3^{\bullet-}$	ozonide	trioxide( $\bullet 1-$ )	trioxidanidyl
$OCl^-$	hypochlorite	oxidochlorate(1-)	
$OBr^-$	hypobromite	oxidobromate(1-)	
$OI^-$	hypoiodite	oxidoiodate(1-)	
$OSCN^-$	hypothiocyanate	oxidothiocyanate(1-)	
$OCOO^{\bullet-}$ or $CO_3^{\bullet-}$	carbonate radical	(dioxido)oxidocarbonate( $\bullet 1-$ )	
$ONOO^-$	peroxynitrite	oxidoperoxidonitrate(1-)	nitrosodioxidanide
$ONOOH$	peroxynitrous acid	hydrogen-oxidoperoxinitrate	nitrosodioxidane
$ONOO^{\bullet}$		(dioxido)oxidonitrogen( $\bullet$ )	nitrosodioxidanyl

## II. Free Radical Nomenclature You Need to Know

**Table 2 Common Abbreviations**

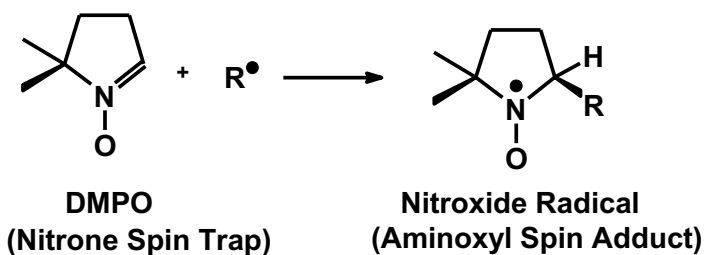
Species/Abbreviation*	Name
	ascorbate, general; ascorbic acid; ascorbate monoanion; ascorbate radical
Asc; AscH <sub>2</sub> , AscH <sup>-</sup> ; Asc <sup>•-</sup>	
	
CAT	catalase
Desferal <sup>®</sup>	trade name for deferoxamine mesylate



Deferrioxamine (Desferal)

5,5-dimethyl-pyrroline-1-oxide, a spin trap

DMPO

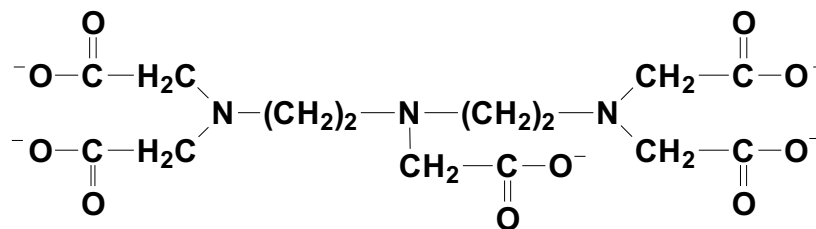


**DMPO**  
**(Nitron Spin Trap)**

**Nitroxide Radical**  
**(Aminoxyl Spin Adduct)**

diethylenetriaminepentaacetic acid (Shown is the completely ionized species.)

DTPA or DETAPAC

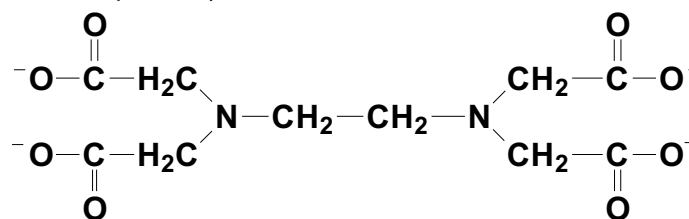


EDRF

endothelium-derived relaxing factor

ethylenediaminetetraacetic acid (Shown is the completely ionized species.)

EDTA



EPR

electron paramagnetic resonance

ESR

electron spin resonance, identical with EPR

G

gauss

GPx

glutathione peroxidase

GR

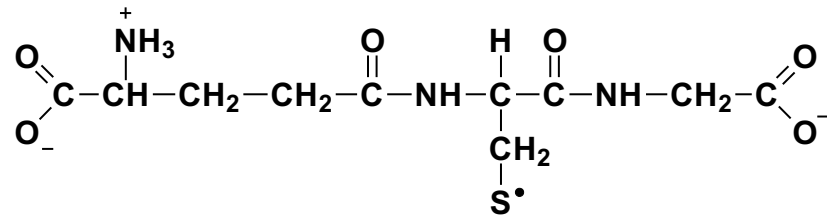
glutathione disulfide reductase; often referred to as glutathione reductase (a misnomer)

Grx

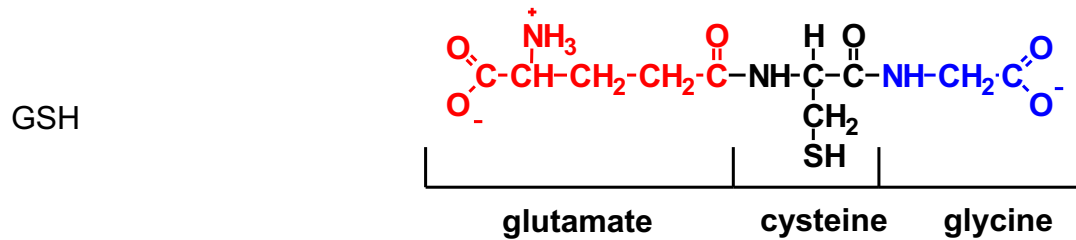
glutaredoxin

GS•

glutathyl radical or glutathionyl radical



Glutathione; not reduced glutathione, a misnomer



GSSG

glutathione disulfide; not oxidized glutathione, a misnomer



GST

glutathione S transferase

H<sup>+</sup>

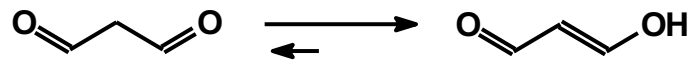
proton, hydron; not to be confused with H<sup>•</sup>

LDL

low density lipoprotein

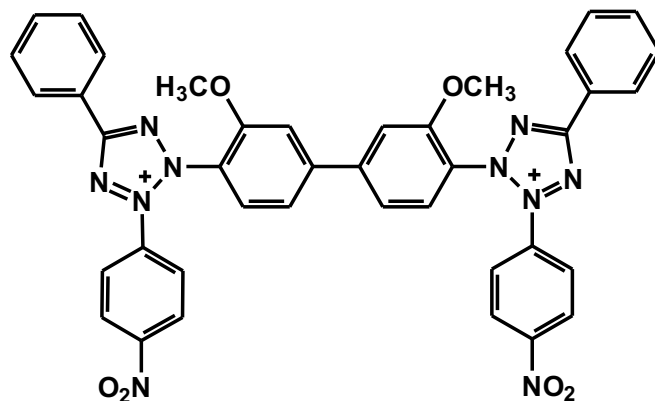
MDA

Malondialdehyde



NBT

nitroblue tetrazolium



NOS

nitric oxide synthase

<sup>1</sup>O<sub>2</sub>

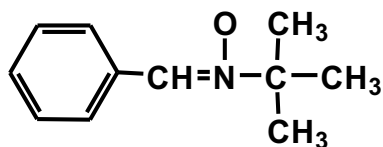
singlet oxygen

OH<sup>-</sup>

hydroxide anion, not to be confused with HO<sup>•</sup>

PBN

α-phenyl-N-tert-butyl nitron, a spin trap



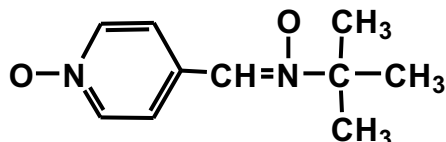
Prxd often Prx

peroxiredoxin

PhGPx

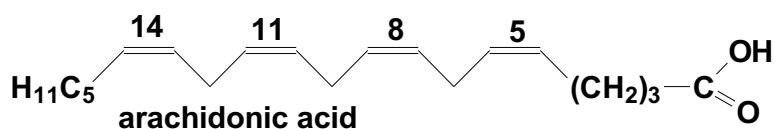
phospholipid hydroperoxide glutathione peroxidase (GPx-4)

POBN

 $\alpha$ -[4-pyridyl 1-oxide]-N-*tert*-butyl nitron, a spin trap

PUFA

polyunsaturated fatty acid, for example



RNS

reactive nitrogen species

RO<sup>•</sup>

alkoxyl radical; not alkoxy

ROO<sup>•</sup>

alkyl dioxygen(•), alkyldioxy, alkylperoxyl radical; not peroxy

ROOH

alkyl hydroperoxide

ROS

reactive oxygen species

R-SH

thiol

R-S<sup>-</sup>

thiolate anion-

R-SOH

sulfenic acid

R-SO<sub>2</sub>H

sulfinic acid

R-SO<sub>3</sub>H

sulfonic acid

SOD

superoxide dismutase

CuZnSOD

copper,zinc-superoxide dismutase (SOD-1)

MnSOD

manganese-superoxide dismutase (SOD-2)

FeSOD

iron-superoxide dismutase

ECSOD

extracellular superoxide dismutase (SOD-3)

TBARS

thiobarbituric acid reactive substances

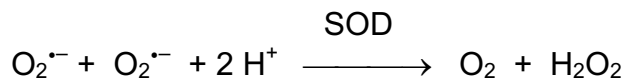
Trx

thioredoxin

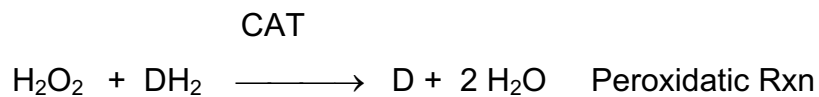
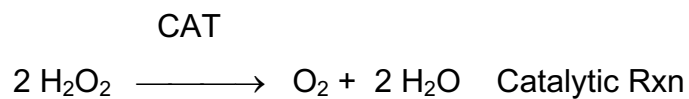
\* These are commonly used abbreviations. Others appear in the literature.

### III. Enzyme Reactions You Must Know to Understand Free Radical Biology

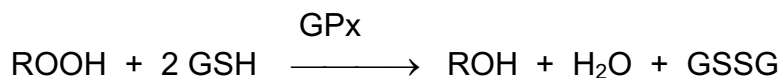
A. The reaction for superoxide dismutase (SOD) is:



B. The reactions for catalase (CAT) are:

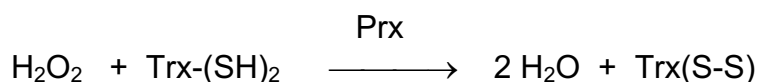


C. The reaction for glutathione peroxidase (GPx) is:

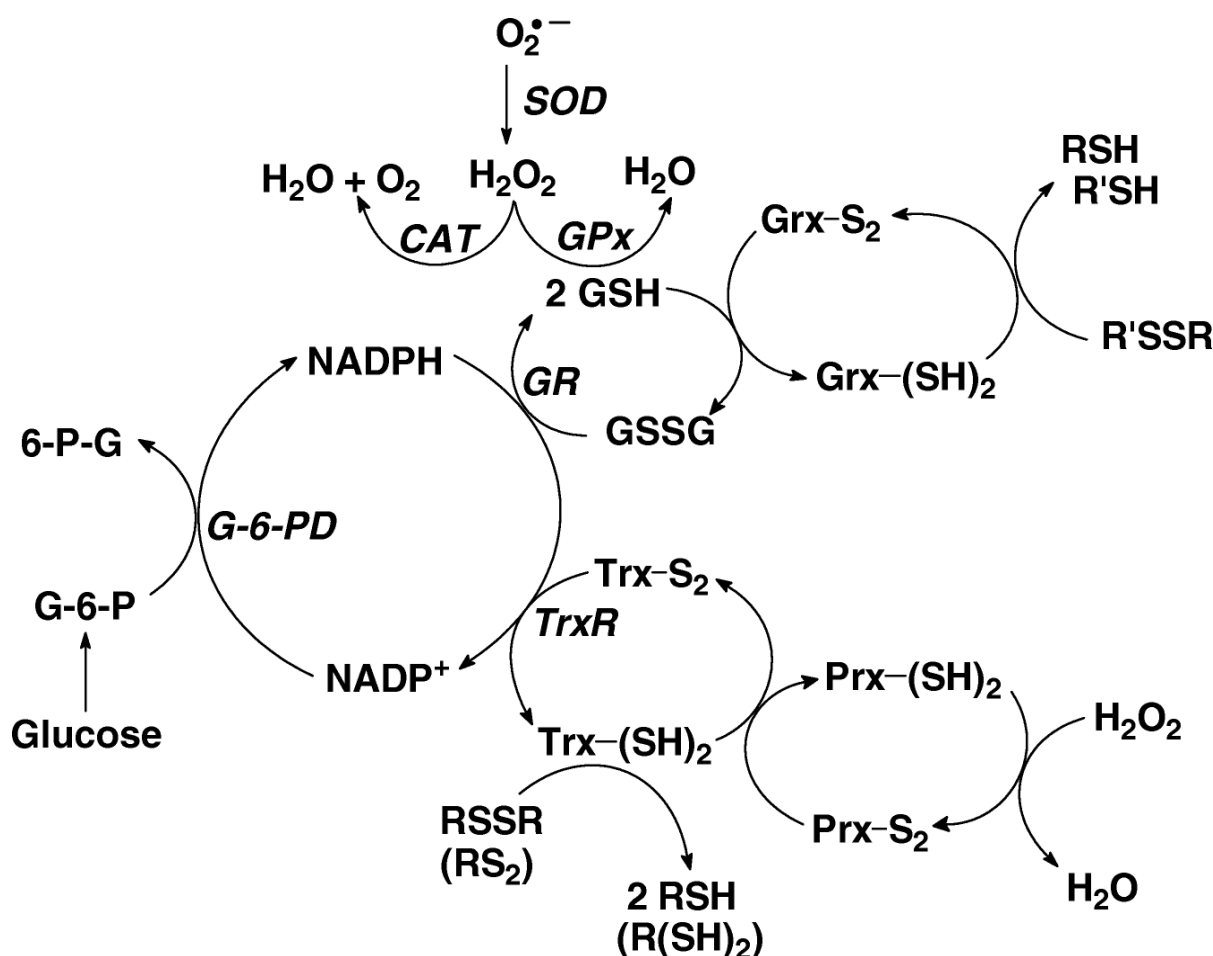


where R = H is allowed.

D. An overview of the reaction of the peroxiredoxins is:



E. Overview of Antioxidant network



This overview is from [7].

End

#### IV. References

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