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<?xml version="1.0"?>

<!-- FILE : purine_nucleotide_degradation_model.xml

CREATED : 7th June 2002

LAST MODIFIED : 22nd July 2002

AUTHOR : Catherine Lloyd
         The Bioengineering Institute
         The University of Auckland

MODEL STATUS : This model conforms to the CellML 1.0 Specification released on
                10th August 2001, and the 16/01/2002 CellML Metadata 1.0
                Specification.

DESCRIPTION : This file contains a CellML description of a generic model of
              purine nucleotide degradation.

CHANGES:
  22/07/2002 - CML - Added more metadata.
-->

<model name="purine_nucleotide_degradation_model" pathway_editor:rendering_config_file="purine_nucleotide_degradation_model.rendering_config.xml"
  <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:bqs="http://www.cellml.org/bqs#"
  <!--
    The following RDF block contains metadata that applies to this document
    as a whole, as indicated by the empty about attribute on the
    <rdf:Description> element.
  -->
  <rdf:Description rdf:about="">
    <!--
      The Model Builder Metadata. The Dublin Core "creator" element is used
      to indicate the person who translated the model into CellML.
    -->
    <dc:creator rdf:parseType="Resource">
      <vCard:N rdf:parseType="Resource">
        <vCard:Family>Lloyd</vCard:Family>
        <vCard:Given>Catherine</vCard:Given>
        <vCard:Other>May</vCard:Other>
      </vCard:N>
      <vCard:EMAIL rdf:parseType="Resource">
        <rdf:value>c.lloyd@auckland.ac.nz</rdf:value>
        <rdf:type rdf:resource="http://imc.org/vCard/3.0#internet" />
      </vCard:EMAIL>
      <vCard:ORG rdf:parseType="Resource">
        <vCard:Orgname>The University of Auckland</vCard:Orgname>
        <vCard:Orgunit>The Bioengineering Institute</vCard:Orgunit>
      </vCard:ORG>
    </dc:creator>

    <!--
      The Creation Date metadata. This is the date on which the model
      was translated into CellML.
    -->
    <dcterms:created rdf:parseType="Resource">
      <dcterms:W3CDTF>2002-06-07</dcterms:W3CDTF>
    </dcterms:created>

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<!--
  The Last Modified Date metadata. This is the date on which
  the model was last changed.
-->
<cmeta:modification rdf:parseType="Resource">
  <rdf:value>
    Added more metadata.
  </rdf:value>
  <cmeta:modifier rdf:parseType="Resource">
    <vCard:N rdf:parseType="Resource">
      <vCard:Family>Lloyd</vCard:Family>
      <vCard:Given>Catherine</vCard:Given>
      <vCard:Other>May</vCard:Other>
    </vCard:N>
  </cmeta:modifier>
  <dcterms:modified rdf:parseType="Resource">
    <dcterms:W3CDTF>2002-07-22</dcterms:W3CDTF>
  </dcterms:modified>
</cmeta:modification>

<!-- The Publisher metadata. -->
<dc:publisher>
  The University of Auckland, Bioengineering Institute
</dc:publisher>
</rdf:Description>

<!--
  The following metadata refers to the model itself, as indicated by the
  reference to the ID "purine_nucleotide_degradation_model", which is
  declared on the <model> element.
-->
<rdf:Description rdf:about="#purine_nucleotide_degradation_model">
  <!-- A human readable name for the model. -->
  <dc:title>A Generic Model Of Purine Nucleotide Degradation</dc:title>

  <!-- A comment regarding the model. -->
  <cmeta:comment rdf:parseType="Resource">
    <rdf:value>
      Below is a CellML description of a general model of purine
      nucleotide degradation. It is not based on a specific published
      mathematical model, but instead it is based on a textbook defined
      pathway. The general sequential structure and all the reactant,
      product and enzyme components are included. Michaelis-Menten enzyme
      kinetics are assumed.

      The purpose of this description is to illustrate how CellML can be
      used to model a general metabolic pathway.
    </rdf:value>
    <!-- The creator of the comment. -->
    <dc:creator>
      <vCard:FN>Catherine Lloyd</vCard:FN>
    </dc:creator>
  </cmeta:comment>

  <cmeta:species>Homo sapiens</cmeta:species>

  <!-- Keyword(s) -->
  <bqs:reference rdf:parseType="Resource">
    <dc:subject rdf:parseType="Resource">

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    <bqs:subject_type>keyword</bqs:subject_type>
    <rdf:value>metabolism</rdf:value>
  </dc:subject>
</bqs:reference>

<bqs:Book rdf:parseType="Resource">
  <dc:creator rdf:parseType="Resource">
    <bqs:Person rdf:parseType="Resource">
      <vCard:N rdf:parseType="Resource">
        <vCard:Family>Bronk</vCard:Family>
        <vCard:Given>J</vCard:Given>
        <vCard:Other>Ramsey</vCard:Other>
      </vCard:N>
    </bqs:Person>
  </dc:creator>
  <dc:title>Human Metabolism</dc:title>
  <dcterms:issued rdf:parseType="Resource">
    <dcterms:W3CDTF>1999</dcterms:W3CDTF>
  </dcterms:issued>
  <dc:publisher rdf:parseType="Resource">
    <bqs:Organisation>Addison Wesley Longman Limited</bqs:Organisation>
    <bqs:Property rdf:parseType="Resource">
      <bqs:property_type>location</bqs:property_type>
      <rdf:value>England</rdf:value>
    </bqs:Property>
  </dc:publisher>
</bqs:Book>
</rdf:Description>
</rdf:RDF>

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  We start the model definition with a definition of some named
  sets of units for use throughout the model.
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<units name="micromolar">
  <unit prefix="micro" units="mole" />
  <unit units="litre" exponent="-1" />
</units>

<units name="flux">
  <unit units="micromolar" />
  <unit units="second" exponent="-1" />
</units>

<units name="second_order_rate_constant">
  <unit units="micromolar" exponent="-1" />
  <unit units="second" exponent="-1" />
</units>

<units name="third_order_rate_constant">
  <unit units="micromolar" exponent="-2" />
  <unit units="second" exponent="-1" />
</units>

<units name="forth_order_rate_constant">
  <unit units="micromolar" exponent="-3" />
  <unit units="second" exponent="-1" />
</units>

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<!--
The following component is defined for modelling convenience. It contains
all the universal variables, in this case, only time.
-->
<component name="global_variables">
  <variable name="time" public_interface="out" units="second" />
</component>

<!--
The following components describe all the metabolites - both reactants and
products - involved in purine nucleotide degradation.
-->

<component name="AMP" cmeta:id="AMP">
  <variable name="AMP" public_interface="out" initial_value="1.0" units="micromolar" />
  <variable name="delta_AMP_rxn0" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>
        <ci>AMP</ci>
      </apply>
      <ci>delta_AMP_rxn0</ci>
    </apply>
  </math>
</component>

<component name="H2O" cmeta:id="H2O">
  <variable name="H2O" public_interface="out" initial_value="1.0" units="micromolar" />
  <variable name="delta_H2O_rxn10" public_interface="in" units="flux" />
  <variable name="delta_H2O_rxn0" public_interface="in" units="flux" />
  <variable name="delta_H2O_rxn1" public_interface="in" units="flux" />
  <variable name="delta_H2O_rxn3" public_interface="in" units="flux" />
  <variable name="delta_H2O_rxn4" public_interface="in" units="flux" />
  <variable name="delta_H2O_rxn6" public_interface="in" units="flux" />
  <variable name="delta_H2O_rxn7" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>
        <ci>H2O</ci>
      </apply>
      <apply>
        <plus />
        <ci>delta_H2O_rxn10</ci>
        <ci>delta_H2O_rxn0</ci>
        <ci>delta_H2O_rxn1</ci>
        <ci>delta_H2O_rxn3</ci>
      </apply>
    </math>
  </component>

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        <ci>delta_H2O_rxn4</ci>
        <ci>delta_H2O_rxn6</ci>
        <ci>delta_H2O_rxn7</ci>
    </apply>
</apply>
</math>
</component>

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<component name="H" cmeta:id="H">
  <variable name="H" public_interface="out" initial_value="1.0" units="micromolar" />
  <variable name="delta_H_rxn3" public_interface="in" units="flux" />
  <variable name="delta_H_rxn7" public_interface="in" units="flux" />
  <variable name="delta_H_rxn0" public_interface="in" units="flux" />
  <variable name="delta_H_rxn4" public_interface="in" units="flux" />
  <variable name="delta_H_rxn9" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>
        <ci>H</ci>
      </apply>
      <apply>
        <plus />
        <ci>delta_H_rxn3</ci>
        <ci>delta_H_rxn7</ci>
        <ci>delta_H_rxn0</ci>
        <ci>delta_H_rxn4</ci>
        <ci>delta_H_rxn9</ci>
      </apply>
    </apply>
  </math>
</component>

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<component name="NH4" cmeta:id="NH4">
  <variable name="NH4" public_interface="out" initial_value="1.0" units="micromolar" />
  <variable name="delta_NH4_rxn0" public_interface="in" units="flux" />
  <variable name="delta_NH4_rxn4" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>
        <ci>NH4</ci>
      </apply>
      <apply>
        <plus />
        <ci>delta_NH4_rxn0</ci>
        <ci>delta_NH4_rxn4</ci>
      </apply>
    </apply>
  </math>
</component>

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</math>
</component>

<component name="Inosine_5_phosphate" cmeta:id="Inosine_5_phosphate">
  <variable name="Inosine_5_phosphate" public_interface="out" initial_value="1.0" units="micromolar" />
  <variable name="delta_Inosine_5_phosphate_rxn0" public_interface="in" units="flux" />
  <variable name="delta_Inosine_5_phosphate_rxn1" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>
        <ci>Inosine_5_phosphate</ci>
      </apply>
      <apply>
        <plus />
        <ci>delta_Inosine_5_phosphate_rxn0</ci>
        <ci>delta_Inosine_5_phosphate_rxn1</ci>
      </apply>
    </apply>
  </math>
</component>

<component name="Pi" cmeta:id="Pi">
  <variable name="Pi" public_interface="out" initial_value="1.0" units="micromolar" />
  <variable name="delta_Pi_rxn1" public_interface="in" units="flux" />
  <variable name="delta_Pi_rxn6" public_interface="in" units="flux" />
  <variable name="delta_Pi_rxn2" public_interface="in" units="flux" />
  <variable name="delta_Pi_rxn5" public_interface="in" units="flux" />
  <variable name="delta_Pi_rxn11" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>
        <ci>Pi</ci>
      </apply>
      <apply>
        <plus />
        <ci>delta_Pi_rxn1</ci>
        <ci>delta_Pi_rxn6</ci>
        <ci>delta_Pi_rxn2</ci>
        <ci>delta_Pi_rxn5</ci>
        <ci>delta_Pi_rxn11</ci>
      </apply>
    </apply>
  </math>
</component>

<component name="Inosine" cmeta:id="Inosine">
  <variable name="Inosine" public_interface="out" initial_value="1.0" units="micromolar" />

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<variable name="delta_Inosine_rxn1" public_interface="in" units="flux" />
<variable name="delta_Inosine_rxn2" public_interface="in" units="flux" />
<variable name="delta_Inosine_rxn11" public_interface="in" units="flux" />
<variable name="time" public_interface="in" units="second" />
<math xmlns="http://www.w3.org/1998/Math/MathML">
  <apply>
    <eq />
    <apply>
      <diff />
      <bvar>
        <ci>time</ci>
      </bvar>
      <ci>Inosine</ci>
    </apply>
    <apply>
      <plus />
      <ci>delta_Inosine_rxn1</ci>
      <ci>delta_Inosine_rxn2</ci>
      <ci>delta_Inosine_rxn11</ci>
    </apply>
  </apply>
</math>
</component>

<component name="Ribose_1_phosphate" cmeta:id="Ribose_1_phosphate">
  <variable name="Ribose_1_phosphate" public_interface="out" initial_value="1.0" units="micromol" />
  <variable name="delta_Ribose_1_phosphate_rxn2" public_interface="in" units="flux" />
  <variable name="delta_Ribose_1_phosphate_rxn5" public_interface="in" units="flux" />
  <variable name="delta_Ribose_1_phosphate_rxn11" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>
        <ci>Ribose_1_phosphate</ci>
      </apply>
      <apply>
        <plus />
        <ci>delta_Ribose_1_phosphate_rxn2</ci>
        <ci>delta_Ribose_1_phosphate_rxn5</ci>
        <ci>delta_Ribose_1_phosphate_rxn11</ci>
      </apply>
    </apply>
  </math>
</component>

<component name="Hypoxanthine" cmeta:id="Hypoxanthine">
  <variable name="Hypoxanthine" public_interface="out" initial_value="1.0" units="micromol" />
  <variable name="delta_Hypoxanthine_rxn2" public_interface="in" units="flux" />
  <variable name="delta_Hypoxanthine_rxn11" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>

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        <diff />
        <bvar>
            <ci>time</ci>
        </bvar>
        <ci>Hypoxanthine</ci>
    </apply>
    <apply>
        <plus />
        <ci>delta_Hypoxanthine_rxn2</ci>
        <ci>delta_Hypoxanthine_rxn11</ci>
    </apply>
</apply>
</math>
</component>

<component name="Xanthine" cmeta:id="Xanthine">
    <variable name="Xanthine" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="delta_Xanthine_rxn3" public_interface="in" units="flux" />
    <variable name="delta_Xanthine_rxn4" public_interface="in" units="flux" />
    <variable name="delta_Xanthine_rxn7" public_interface="in" units="flux" />
    <variable name="time" public_interface="in" units="second" />
    <math xmlns="http://www.w3.org/1998/Math/MathML">
        <apply>
            <eq />
            <apply>
                <diff />
                <bvar>
                    <ci>time</ci>
                </bvar>
                <ci>Xanthine</ci>
            </apply>
            <apply>
                <plus />
                <ci>delta_Xanthine_rxn3</ci>
                <ci>delta_Xanthine_rxn4</ci>
                <ci>delta_Xanthine_rxn7</ci>
            </apply>
        </apply>
    </math>
</component>

<component name="O2" cmeta:id="O2">
    <variable name="O2" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="delta_O2_rxn9" public_interface="in" units="flux" />
    <variable name="delta_O2_rxn10" public_interface="in" units="flux" />
    <variable name="delta_O2_rxn3" public_interface="in" units="flux" />
    <variable name="delta_O2_rxn7" public_interface="in" units="flux" />
    <variable name="time" public_interface="in" units="second" />
    <math xmlns="http://www.w3.org/1998/Math/MathML">
        <apply>
            <eq />
            <apply>
                <diff />
                <bvar>
                    <ci>time</ci>
                </bvar>
                <ci>O2</ci>
            </apply>
        </apply>
    </math>
</component>

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        <plus />
        <ci>delta_02_rxn9</ci>
        <ci>delta_02_rxn10</ci>
        <ci>delta_02_rxn3</ci>
        <ci>delta_02_rxn7</ci>
    </apply>
</apply>
</math>
</component>

<component name="O2_free_radical" cmeta:id="O2_free_radical">
    <variable name="O2_free_radical" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="delta_02_free_radical_rxn3" public_interface="in" units="flux" />
    <variable name="delta_02_free_radical_rxn7" public_interface="in" units="flux" />
    <variable name="delta_02_free_radical_rxn8" public_interface="in" units="flux" />
    <variable name="delta_02_free_radical_rxn9" public_interface="in" units="flux" />
    <variable name="time" public_interface="in" units="second" />
    <math xmlns="http://www.w3.org/1998/Math/MathML">
        <apply>
            <eq />
            <apply>
                <diff />
                <bvar>
                    <ci>time</ci>
                </bvar>
                <ci>O2_free_radical</ci>
            </apply>
            <apply>
                <plus />
                <ci>delta_02_free_radical_rxn3</ci>
                <ci>delta_02_free_radical_rxn7</ci>
                <ci>delta_02_free_radical_rxn8</ci>
                <ci>delta_02_free_radical_rxn9</ci>
            </apply>
        </apply>
    </math>
</component>

<component name="Guanine" cmeta:id="Guanine">
    <variable name="Guanine" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="delta_Guanine_rxn5" public_interface="in" units="flux" />
    <variable name="delta_Guanine_rxn4" public_interface="in" units="flux" />
    <variable name="time" public_interface="in" units="second" />
    <math xmlns="http://www.w3.org/1998/Math/MathML">
        <apply>
            <eq />
            <apply>
                <diff />
                <bvar>
                    <ci>time</ci>
                </bvar>
                <ci>Guanine</ci>
            </apply>
            <apply>
                <plus />
                <ci>delta_Guanine_rxn5</ci>
                <ci>delta_Guanine_rxn4</ci>
            </apply>
        </apply>
    </math>
</component>

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</math>
</component>

<component name="Guanosine" cmeta:id="Guanosine">
  <variable name="Guanosine" public_interface="out" initial_value="1.0" units="micromolar" />
  <variable name="delta_Guanosine_rxn6" public_interface="in" units="flux" />
  <variable name="delta_Guanosine_rxn5" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>
        <ci>Guanosine</ci>
      </apply>
      <apply>
        <plus />
        <ci>delta_Guanosine_rxn6</ci>
        <ci>delta_Guanosine_rxn5</ci>
      </apply>
    </apply>
  </math>
</component>

<component name="GMP" cmeta:id="GMP">
  <variable name="GMP" public_interface="out" initial_value="1.0" units="micromolar" />
  <variable name="delta_GMP_rxn6" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>
        <ci>GMP</ci>
      </apply>
      <ci>delta_GMP_rxn6</ci>
    </apply>
  </math>
</component>

<component name="Urate" cmeta:id="Urate">
  <variable name="Urate" public_interface="out" initial_value="1.0" units="micromolar" />
  <variable name="delta_Urate_rxn7" public_interface="in" units="flux" />
  <variable name="delta_Urate_rxn8" public_interface="in" units="flux" />
  <variable name="time" public_interface="in" units="second" />
  <math xmlns="http://www.w3.org/1998/Math/MathML">
    <apply>
      <eq />
      <apply>
        <diff />
        <bvar>
          <ci>time</ci>
        </bvar>

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        <ci>Urate</ci>
    </apply>
    <apply>
        <plus />
        <ci>delta_Urate_rxn7</ci>
        <ci>delta_Urate_rxn8</ci>
    </apply>
</apply>
</math>
</component>

<component name="CO2" cmeta:id="CO2">
    <variable name="CO2" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="delta_CO2_rxn8" public_interface="in" units="flux" />
    <variable name="time" public_interface="in" units="second" />
    <math xmlns="http://www.w3.org/1998/Math/MathML">
        <apply>
            <eq />
            <apply>
                <diff />
                <bvar>
                    <ci>time</ci>
                </bvar>
                <ci>CO2</ci>
            </apply>
            <ci>delta_CO2_rxn8</ci>
        </apply>
    </math>
</component>

<component name="Allantoin" cmeta:id="Allantoin">
    <variable name="Allantoin" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="delta_Allantoin_rxn8" public_interface="in" units="flux" />
    <variable name="time" public_interface="in" units="second" />
    <math xmlns="http://www.w3.org/1998/Math/MathML">
        <apply>
            <eq />
            <apply>
                <diff />
                <bvar>
                    <ci>time</ci>
                </bvar>
                <ci>Allantoin</ci>
            </apply>
            <ci>delta_Allantoin_rxn8</ci>
        </apply>
    </math>
</component>

<component name="H2O2" cmeta:id="H2O2">
    <variable name="H2O2" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="delta_H2O2_rxn9" public_interface="in" units="flux" />
    <variable name="delta_H2O2_rxn10" public_interface="in" units="flux" />
    <variable name="time" public_interface="in" units="second" />
    <math xmlns="http://www.w3.org/1998/Math/MathML">
        <apply>
            <eq />
            <apply>
                <diff />

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```

        <bvar>
            <ci>time</ci>
        </bvar>
        <ci>H2O2</ci>
    </apply>
    <apply>
        <plus />
        <ci>delta_H2O2_rxn9</ci>
        <ci>delta_H2O2_rxn10</ci>
    </apply>
</apply>
</math>
</component>

<!--
    The following components describe all the enzymes involved in purine
    nucleotide degradation.
-->

<component name="Catalase" cmeta:id="Catalase">
    <variable name="Catalase" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="time" public_interface="in" units="second" />
</component>

<component name="Nucleotidase_5" cmeta:id="Nucleotidase_5">
    <variable name="Nucleotidase_5" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="time" public_interface="in" units="second" />
</component>

<component name="AMP_5_deaminase" cmeta:id="AMP_5_deaminase">
    <variable name="AMP_5_deaminase" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="time" public_interface="in" units="second" />
</component>

<component name="Nucleoside_phosphorylase" cmeta:id="Nucleoside_phosphorylase">
    <variable name="Nucleoside_phosphorylase" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="time" public_interface="in" units="second" />
</component>

<component name="Guanine_deaminase" cmeta:id="Guanine_deaminase">
    <variable name="Guanine_deaminase" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="time" public_interface="in" units="second" />
</component>

<component name="Xanthine_oxidase" cmeta:id="Xanthine_oxidase">
    <variable name="Xanthine_oxidase" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="time" public_interface="in" units="second" />
</component>

<component name="Superoxide_dismutase" cmeta:id="Superoxide_dismutase">
    <variable name="Superoxide_dismutase" public_interface="out" initial_value="1.0" units="micromolar" />
    <variable name="time" public_interface="in" units="second" />
</component>

<!--
    The following components represent the reaction steps of purine
    nucleotide degradation.
-->

```

```

<component name="reaction0">
  <variable name="H2O" public_interface="in" units="micromolar" />
  <variable name="AMP" public_interface="in" units="micromolar" />
  <variable name="H" public_interface="in" units="micromolar" />
  <variable name="NH4" public_interface="in" units="micromolar" />
  <variable name="Inosine_5_phosphate" public_interface="in" units="micromolar" />
  <variable name="AMP_5_deaminase" public_interface="in" units="micromolar" />
  <variable name="delta_H2O_rxn0" public_interface="out" units="flux" />
  <variable name="delta_AMP_rxn0" public_interface="out" units="flux" />
  <variable name="delta_H_rxn0" public_interface="out" units="flux" />
  <variable name="delta_NH4_rxn0" public_interface="out" units="flux" />
  <variable name="delta_Inosine_5_phosphate_rxn0" public_interface="out" units="flux" />
  <variable name="vmax0" initial_value="1.0" units="third_order_rate_constant" />
  <variable name="km0" initial_value="1.0" units="micromolar" />
  <variable name="rate" units="flux" />
  <reaction reversible="no">
    <variable_ref variable="H2O">
      <role role="reactant" delta_variable="delta_H2O_rxn0" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="AMP">
      <role role="reactant" delta_variable="delta_AMP_rxn0" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="H">
      <role role="reactant" delta_variable="delta_H_rxn0" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="NH4">
      <role role="product" delta_variable="delta_NH4_rxn0" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Inosine_5_phosphate">
      <role role="product" delta_variable="delta_Inosine_5_phosphate_rxn0" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="AMP_5_deaminase">
      <role role="catalyst" />
    </variable_ref>
    <variable_ref variable="rate">
      <role role="rate">
        <math xmlns="http://www.w3.org/1998/Math/MathML">
          <apply>
            <eq />
            <ci>rate</ci>
            <apply><divide />
              <apply><times />
                <ci>vmax0</ci>
                <ci>H2O</ci>
                <ci>AMP</ci>
                <ci>H</ci>
              </apply>
            <apply><plus />
              <ci>km0</ci>
              <ci>H2O</ci>
              <ci>AMP</ci>
              <ci>H</ci>
            </apply>
          </apply>
        </math>
      </role>
    </variable_ref>
  </reaction>
</component>

```

</component>

<component name="reaction1">

```
<variable name="Inosine_5_phosphate" public_interface="in" units="micromolar" />
<variable name="H2O" public_interface="in" units="micromolar" />
<variable name="Pi" public_interface="in" units="micromolar" />
<variable name="Inosine" public_interface="in" units="micromolar" />
<variable name="Nucleotidase_5" public_interface="in" units="micromolar" />
<variable name="delta_Inosine_5_phosphate_rxn1" public_interface="out" units="flux" />
<variable name="delta_H2O_rxn1" public_interface="out" units="flux" />
<variable name="delta_Pi_rxn1" public_interface="out" units="flux" />
<variable name="delta_Inosine_rxn1" public_interface="out" units="flux" />
<variable name="vmax1" initial_value="1.0" units="second_order_rate_constant" />
<variable name="kml" initial_value="1.0" units="micromolar" />
<variable name="rate" units="flux" />
```

<reaction reversible="no">

```
<variable_ref variable="Inosine_5_phosphate">
```

```
<role role="reactant" delta_variable="delta_Inosine_5_phosphate_rxn1" stoichiometry="1" />
```

```
</variable_ref>
```

```
<variable_ref variable="H2O">
```

```
<role role="reactant" delta_variable="delta_H2O_rxn1" stoichiometry="1" />
```

```
</variable_ref>
```

```
<variable_ref variable="Pi">
```

```
<role role="product" delta_variable="delta_Pi_rxn1" stoichiometry="1" />
```

```
</variable_ref>
```

```
<variable_ref variable="Inosine">
```

```
<role role="product" delta_variable="delta_Inosine_rxn1" stoichiometry="1" />
```

```
</variable_ref>
```

```
<variable_ref variable="Nucleotidase_5">
```

```
<role role="catalyst" />
```

```
</variable_ref>
```

```
<variable_ref variable="rate">
```

```
<role role="rate">
```

```
<math xmlns="http://www.w3.org/1998/Math/MathML">
```

```
<apply>
```

```
<eq />
```

```
<ci>rate</ci>
```

```
<apply><divide />
```

```
<apply><times />
```

```
<ci>vmax1</ci>
```

```
<ci>Inosine_5_phosphate</ci>
```

```
<ci>H2O</ci>
```

```
</apply>
```

```
<apply><plus />
```

```
<ci>kml</ci>
```

```
<ci>Inosine_5_phosphate</ci>
```

```
<ci>H2O</ci>
```

```
</apply>
```

```
</apply>
```

```
</math>
```

```
</role>
```

```
</variable_ref>
```

```
</reaction>
```

</component>

<component name="reaction2">

```
<variable name="Inosine" public_interface="in" units="micromolar" />
```

```
<variable name="Pi" public_interface="in" units="micromolar" />
```

```

<variable name="Ribose_1_phosphate" public_interface="in" units="micromolar" />
<variable name="Hypoxanthine" public_interface="in" units="micromolar" />
<variable name="Nucleoside_phosphorylase" public_interface="in" units="micromolar" />
<variable name="delta_Inosine_rxn2" public_interface="out" units="flux" />
<variable name="delta_Pi_rxn2" public_interface="out" units="flux" />
<variable name="delta_Ribose_1_phosphate_rxn2" public_interface="out" units="flux" />
<variable name="delta_Hypoxanthine_rxn2" public_interface="out" units="flux" />
<variable name="km2" initial_value="1.0" units="micromolar" />
<variable name="vmax2" initial_value="1.0" units="second_order_rate_constant" />
<variable name="rate" units="flux" />
<reaction reversible="no">
  <variable_ref variable="Inosine">
    <role role="reactant" delta_variable="delta_Inosine_rxn2" stoichiometry="1" />
  </variable_ref>
  <variable_ref variable="Pi">
    <role role="reactant" delta_variable="delta_Pi_rxn2" stoichiometry="1" />
  </variable_ref>
  <variable_ref variable="Ribose_1_phosphate">
    <role role="product" delta_variable="delta_Ribose_1_phosphate_rxn2" stoichiometry="1" />
  </variable_ref>
  <variable_ref variable="Hypoxanthine">
    <role role="product" delta_variable="delta_Hypoxanthine_rxn2" stoichiometry="1" />
  </variable_ref>
  <variable_ref variable="Nucleoside_phosphorylase">
    <role role="catalyst" />
  </variable_ref>
  <variable_ref variable="rate">
    <role role="rate">
      <math xmlns="http://www.w3.org/1998/Math/MathML">
        <apply>
          <eq />
          <ci>rate</ci>
          <apply>
            <divide />
            <apply>
              <times />
              <ci>Inosine</ci>
              <ci>Pi</ci>
              <ci>vmax2</ci>
            </apply>
            <apply>
              <plus />
              <ci>km2</ci>
              <ci>Inosine</ci>
              <ci>Pi</ci>
            </apply>
          </apply>
        </math>
      </role>
    </variable_ref>
  </reaction>
</component>

<component name="reaction3">
  <variable name="O2" public_interface="in" units="micromolar" />
  <variable name="Hypoxanthine" public_interface="in" units="micromolar" />
  <variable name="H2O" public_interface="in" units="micromolar" />
  <variable name="O2_free_radical" public_interface="in" units="micromolar" />

```

```

<variable name="Xanthine" public_interface="in" units="micromolar" />
<variable name="H" public_interface="in" units="micromolar" />
<variable name="Xanthine_oxidase" public_interface="in" units="micromolar" />
<variable name="delta_O2_rxn3" public_interface="out" units="flux" />
<variable name="delta_Hypoxanthine_rxn3" public_interface="out" units="flux" />
<variable name="delta_H2O_rxn3" public_interface="out" units="flux" />
<variable name="delta_O2_free_radical_rxn3" public_interface="out" units="flux" />
<variable name="delta_Xanthine_rxn3" public_interface="out" units="flux" />
<variable name="delta_H_rxn3" public_interface="out" units="flux" />
<variable name="km3" initial_value="1.0" units="micromolar" />
<variable name="vmax3" initial_value="1.0" units="third_order_rate_constant" />
<variable name="rate" units="flux" />
<reaction reversible="no">
  <variable_ref variable="O2">
    <role role="reactant" delta_variable="delta_O2_rxn3" stoichiometry="1" />
  </variable_ref>
  <variable_ref variable="Hypoxanthine">
    <role role="reactant" delta_variable="delta_Hypoxanthine_rxn3" stoichiometry="1" />
  </variable_ref>
  <variable_ref variable="H2O">
    <role role="reactant" delta_variable="delta_H2O_rxn3" stoichiometry="1" />
  </variable_ref>
  <variable_ref variable="O2_free_radical">
    <role role="product" delta_variable="delta_O2_free_radical_rxn3" stoichiometry="1" />
  </variable_ref>
  <variable_ref variable="Xanthine">
    <role role="product" delta_variable="delta_Xanthine_rxn3" stoichiometry="1" />
  </variable_ref>
  <variable_ref variable="H">
    <role role="product" delta_variable="delta_H_rxn3" stoichiometry="2" />
  </variable_ref>
  <variable_ref variable="Xanthine_oxidase">
    <role role="catalyst" />
  </variable_ref>
  <variable_ref variable="rate">
    <role role="rate">
      <math xmlns="http://www.w3.org/1998/Math/MathML">
        <apply>
          <eq />
          <ci>rate</ci>
          <apply>
            <divide />
            <apply>
              <times />
              <ci>O2</ci>
              <ci>Hypoxanthine</ci>
              <ci>H2O</ci>
              <ci>vmax3</ci>
            </apply>
            <plus />
            <ci>km3</ci>
            <ci>O2</ci>
            <ci>Hypoxanthine</ci>
            <ci>H2O</ci>
          </apply>
        </math>
      </role>
    </variable_ref>
  </reaction>

```

```

    </role>
  </variable_ref>
</reaction>
</component>

<component name="reaction4">
  <variable name="H2O" public_interface="in" units="micromolar" />
  <variable name="H" public_interface="in" units="micromolar" />
  <variable name="Guanine" public_interface="in" units="micromolar" />
  <variable name="NH4" public_interface="in" units="micromolar" />
  <variable name="Xanthine" public_interface="in" units="micromolar" />
  <variable name="Guanine_deaminase" public_interface="in" units="micromolar" />
  <variable name="delta_H2O_rxn4" public_interface="out" units="flux" />
  <variable name="delta_H_rxn4" public_interface="out" units="flux" />
  <variable name="delta_Guanine_rxn4" public_interface="out" units="flux" />
  <variable name="delta_NH4_rxn4" public_interface="out" units="flux" />
  <variable name="delta_Xanthine_rxn4" public_interface="out" units="flux" />
  <variable name="km4" initial_value="1.0" units="micromolar" />
  <variable name="vmax4" initial_value="1.0" units="third_order_rate_constant" />
  <variable name="rate" units="flux" />
  <reaction reversible="no">
    <variable_ref variable="H2O">
      <role role="reactant" delta_variable="delta_H2O_rxn4" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="H">
      <role role="reactant" delta_variable="delta_H_rxn4" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Guanine">
      <role role="reactant" delta_variable="delta_Guanine_rxn4" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="NH4">
      <role role="product" delta_variable="delta_NH4_rxn4" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Xanthine">
      <role role="product" delta_variable="delta_Xanthine_rxn4" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Guanine_deaminase">
      <role role="catalyst" />
    </variable_ref>
    <variable_ref variable="rate">
      <role role="rate">
        <math xmlns="http://www.w3.org/1998/Math/MathML">
          <apply>
            <eq />
            <ci>rate</ci>
            <apply>
              <divide />
              <apply>
                <times />
                <ci>H2O</ci>
                <ci>H</ci>
                <ci>Guanine</ci>
                <ci>vmax4</ci>
              </apply>
            </apply>
            <apply>
              <plus />
              <ci>km4</ci>
              <ci>H2O</ci>
              <ci>H</ci>
            </apply>
          </math>
        </role>
      </variable_ref>
    </reaction>
  </component>

```

```

        <ci>Guanine</ci>
      </apply>
    </apply>
  </math>
</role>
</variable_ref>
</reaction>
</component>

<component name="reaction5">
  <variable name="Guanosine" public_interface="in" units="micromolar" />
  <variable name="Pi" public_interface="in" units="micromolar" />
  <variable name="Ribose_1_phosphate" public_interface="in" units="micromolar" />
  <variable name="Guanine" public_interface="in" units="micromolar" />
  <variable name="Nucleoside_phosphorylase" public_interface="in" units="micromolar" />
  <variable name="delta_Guanosine_rxn5" public_interface="out" units="flux" />
  <variable name="delta_Pi_rxn5" public_interface="out" units="flux" />
  <variable name="delta_Ribose_1_phosphate_rxn5" public_interface="out" units="flux" />
  <variable name="delta_Guanine_rxn5" public_interface="out" units="flux" />
  <variable name="km5" initial_value="1.0" units="micromolar" />
  <variable name="vmax5" initial_value="1.0" units="second_order_rate_constant" />
  <variable name="rate" units="flux" />
  <reaction reversible="no">
    <variable_ref variable="Guanosine">
      <role role="reactant" delta_variable="delta_Guanosine_rxn5" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Pi">
      <role role="reactant" delta_variable="delta_Pi_rxn5" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Ribose_1_phosphate">
      <role role="product" delta_variable="delta_Ribose_1_phosphate_rxn5" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Guanine">
      <role role="product" delta_variable="delta_Guanine_rxn5" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Nucleoside_phosphorylase">
      <role role="catalyst" direction="forward" />
    </variable_ref>
    <variable_ref variable="rate">
      <role role="rate">
        <math xmlns="http://www.w3.org/1998/Math/MathML">
          <apply>
            <eq />
            <ci>rate</ci>
            <apply>
              <divide />
              <apply>
                <times />
                <ci>Guanosine</ci>
                <ci>Pi</ci>
                <ci>vmax5</ci>
              </apply>
            <plus />
            <ci>km5</ci>
            <ci>Guanosine</ci>
            <ci>Pi</ci>
          </apply>
        </math>
      </role>
    </variable_ref>
  </reaction>
</component>

```

```

        </apply>
      </apply>
    </math>
  </role>
</variable_ref>
</reaction>
</component>

<component name="reaction6">
  <variable name="GMP" public_interface="in" units="micromolar" />
  <variable name="H2O" public_interface="in" units="micromolar" />
  <variable name="Pi" public_interface="in" units="micromolar" />
  <variable name="Guanosine" public_interface="in" units="micromolar" />
  <variable name="Nucleotidase_5" public_interface="in" units="micromolar" />
  <variable name="delta_GMP_rxn6" public_interface="out" units="flux" />
  <variable name="delta_H2O_rxn6" public_interface="out" units="flux" />
  <variable name="delta_Pi_rxn6" public_interface="out" units="flux" />
  <variable name="delta_Guanosine_rxn6" public_interface="out" units="flux" />
  <variable name="km6" initial_value="1.0" units="micromolar" />
  <variable name="vmax6" initial_value="1.0" units="second_order_rate_constant" />
  <variable name="rate" units="flux" />
  <reaction reversible="no">
    <variable_ref variable="GMP">
      <role role="reactant" delta_variable="delta_GMP_rxn6" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="H2O">
      <role role="reactant" delta_variable="delta_H2O_rxn6" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Pi">
      <role role="product" delta_variable="delta_Pi_rxn6" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Guanosine">
      <role role="product" delta_variable="delta_Guanosine_rxn6" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Nucleotidase_5">
      <role role="catalyst" direction="forward" />
    </variable_ref>
    <variable_ref variable="rate">
      <role role="rate">
        <math xmlns="http://www.w3.org/1998/Math/MathML">
          <apply>
            <eq />
            <ci>rate</ci>
            <apply>
              <divide />
              <apply>
                <times />
                <ci>GMP</ci>
                <ci>H2O</ci>
                <ci>vmax6</ci>
              </apply>
            </apply>
            <plus />
            <ci>km6</ci>
            <ci>GMP</ci>
            <ci>H2O</ci>
          </apply>
        </math>
      </role>
    </variable_ref>
  </reaction>
</component>

```

```

        </math>
      </role>
    </variable_ref>
  </reaction>
</component>

<component name="reaction7">
  <variable name="H2O" public_interface="in" units="micromolar" />
  <variable name="Xanthine" public_interface="in" units="micromolar" />
  <variable name="O2" public_interface="in" units="micromolar" />
  <variable name="H" public_interface="in" units="micromolar" />
  <variable name="Urate" public_interface="in" units="micromolar" />
  <variable name="O2_free_radical" public_interface="in" units="micromolar" />
  <variable name="Xanthine_oxidase" public_interface="in" units="micromolar" />
  <variable name="delta_H2O_rxn7" public_interface="out" units="flux" />
  <variable name="delta_Xanthine_rxn7" public_interface="out" units="flux" />
  <variable name="delta_O2_rxn7" public_interface="out" units="flux" />
  <variable name="delta_H_rxn7" public_interface="out" units="flux" />
  <variable name="delta_Urate_rxn7" public_interface="out" units="flux" />
  <variable name="delta_O2_free_radical_rxn7" public_interface="out" units="flux" />
  <variable name="km7" initial_value="1.0" units="micromolar" />
  <variable name="vmax7" initial_value="1.0" units="third_order_rate_constant" />
  <variable name="rate" units="flux" />
  <reaction reversible="no">
    <variable_ref variable="H2O">
      <role role="reactant" delta_variable="delta_H2O_rxn7" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Xanthine">
      <role role="reactant" delta_variable="delta_Xanthine_rxn7" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="O2">
      <role role="reactant" delta_variable="delta_O2_rxn7" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="H">
      <role role="product" delta_variable="delta_H_rxn7" stoichiometry="2" />
    </variable_ref>
    <variable_ref variable="Urate">
      <role role="product" delta_variable="delta_Urate_rxn7" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="O2_free_radical">
      <role role="product" delta_variable="delta_O2_free_radical_rxn7" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Xanthine_oxidase">
      <role role="catalyst" direction="forward" />
    </variable_ref>
    <variable_ref variable="rate">
      <role role="rate">
        <math xmlns="http://www.w3.org/1998/Math/MathML">
          <apply>
            <eq />
            <ci>rate</ci>
            <apply>
              <divide />
              <apply>
                <times />
                <ci>H2O</ci>
                <ci>Xanthine</ci>
                <ci>O2</ci>
                <ci>vmax7</ci>
              </apply>
            </apply>
          </math>
        </role>
      </variable_ref>
    </reaction>
  </component>

```

```

        </apply>
        <apply>
            <plus />
            <ci>km7</ci>
            <ci>H2O</ci>
            <ci>Xanthine</ci>
            <ci>O2</ci>
        </apply>
    </apply>
</math>
</role>
</variable_ref>
</reaction>
</component>

<component name="reaction8">
    <variable name="O2_free_radical" public_interface="in" units="micromolar" />
    <variable name="Urate" public_interface="in" units="micromolar" />
    <variable name="CO2" public_interface="in" units="micromolar" />
    <variable name="Allantoin" public_interface="in" units="micromolar" />
    <variable name="delta_O2_free_radical_rxn8" public_interface="out" units="flux" />
    <variable name="delta_Urate_rxn8" public_interface="out" units="flux" />
    <variable name="delta_CO2_rxn8" public_interface="out" units="flux" />
    <variable name="delta_Allantoin_rxn8" public_interface="out" units="flux" />
    <variable name="k8" initial_value="1.0" units="second_order_rate_constant" />
    <variable name="rate" units="flux" />
    <reaction reversible="no">
        <variable_ref variable="O2_free_radical">
            <role role="reactant" delta_variable="delta_O2_free_radical_rxn8" stoichiometry="1" />
        </variable_ref>
        <variable_ref variable="Urate">
            <role role="reactant" delta_variable="delta_Urate_rxn8" stoichiometry="1" />
        </variable_ref>
        <variable_ref variable="CO2">
            <role role="product" delta_variable="delta_CO2_rxn8" stoichiometry="1" />
        </variable_ref>
        <variable_ref variable="Allantoin">
            <role role="product" delta_variable="delta_Allantoin_rxn8" stoichiometry="1" />
        </variable_ref>
        <variable_ref variable="rate">
            <role role="rate">
                <math xmlns="http://www.w3.org/1998/Math/MathML">
                    <apply>
                        <eq />
                        <ci>rate</ci>
                    <apply>
                        <times />
                        <ci>k8</ci>
                        <ci>O2_free_radical</ci>
                        <ci>Urate</ci>
                    </apply>
                </math>
            </role>
        </variable_ref>
    </reaction>
</component>

```

```

<component name="reaction9">
  <variable name="H" public_interface="in" units="micromolar" />
  <variable name="O2_free_radical" public_interface="in" units="micromolar" />
  <variable name="O2" public_interface="in" units="micromolar" />
  <variable name="H2O2" public_interface="in" units="micromolar" />
  <variable name="Superoxide_dismutase" public_interface="in" units="micromolar" />
  <variable name="delta_H_rxn9" public_interface="out" units="flux" />
  <variable name="delta_O2_free_radical_rxn9" public_interface="out" units="flux" />
  <variable name="delta_O2_rxn9" public_interface="out" units="flux" />
  <variable name="delta_H2O2_rxn9" public_interface="out" units="flux" />
  <variable name="km9" initial_value="1.0" units="micromolar" />
  <variable name="vmax9" initial_value="1.0" units="forth_order_rate_constant" />
  <variable name="rate" units="flux" />
  <reaction reversible="no">
    <variable_ref variable="H">
      <role role="reactant" delta_variable="delta_H_rxn9" stoichiometry="2" />
    </variable_ref>
    <variable_ref variable="O2_free_radical">
      <role role="reactant" delta_variable="delta_O2_free_radical_rxn9" stoichiometry=
    </variable_ref>
    <variable_ref variable="O2">
      <role role="product" delta_variable="delta_O2_rxn9" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="H2O2">
      <role role="product" delta_variable="delta_H2O2_rxn9" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Superoxide_dismutase">
      <role role="catalyst" direction="forward" />
    </variable_ref>
    <variable_ref variable="rate">
      <role role="rate">
        <math xmlns="http://www.w3.org/1998/Math/MathML">
          <apply>
            <eq />
            <ci>rate</ci>
            <apply>
              <divide />
              <apply>
                <times />
                <apply>
                  <power />
                  <ci>H</ci>
                  <cn cellml:units="dimensionless"> 2.0 </cn>
                </apply>
                <apply>
                  <power />
                  <ci>O2_free_radical</ci>
                  <cn cellml:units="dimensionless"> 2.0 </cn>
                </apply>
                <ci>vmax9</ci>
              </apply>
            <plus />
            <ci>km9</ci>
            <apply>
              <power />
              <ci>H</ci>
              <cn cellml:units="dimensionless"> 2.0 </cn>
            </apply>
          </math>
        </role>
      </variable_ref>
    </reaction>
  </component>

```

```

        <apply>
          <power />
          <ci>O2_free_radical</ci>
          <cn cellml:units="dimensionless"> 2.0 </cn>
        </apply>
      </apply>
    </apply>
  </math>
</variable_ref>
</reaction>
</component>

<component name="reaction10">
  <variable name="H2O2" public_interface="in" units="micromolar" />
  <variable name="H2O" public_interface="in" units="micromolar" />
  <variable name="O2" public_interface="in" units="micromolar" />
  <variable name="Catalase" public_interface="in" units="micromolar" />
  <variable name="delta_H2O2_rxn10" public_interface="out" units="flux" />
  <variable name="delta_H2O_rxn10" public_interface="out" units="flux" />
  <variable name="delta_O2_rxn10" public_interface="out" units="flux" />
  <variable name="km10" initial_value="1.0" units="micromolar" />
  <variable name="vmax10" initial_value="1.0" units="second_order_rate_constant" />
  <variable name="rate" units="flux" />
  <reaction reversible="no">
    <variable_ref variable="H2O2">
      <role role="reactant" delta_variable="delta_H2O2_rxn10" stoichiometry="2" />
    </variable_ref>
    <variable_ref variable="H2O">
      <role role="product" delta_variable="delta_H2O_rxn10" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="O2">
      <role role="product" delta_variable="delta_O2_rxn10" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Catalase">
      <role role="catalyst" />
    </variable_ref>
    <variable_ref variable="rate">
      <role role="rate">
        <math xmlns="http://www.w3.org/1998/Math/MathML">
          <apply>
            <eq />
            <ci>rate</ci>
            <apply>
              <divide />
              <apply>
                <times />
                <apply>
                  <power />
                  <ci>H2O2</ci>
                  <cn cellml:units="dimensionless"> 2.0 </cn>
                </apply>
                <ci>vmax10</ci>
              </apply>
              <plus />
              <ci>km10</ci>
            </apply>
          </math>

```

```

        <power />
        <ci>H2O2</ci>
        <cn cellml:units="dimensionless"> 2.0 </cn>
    </apply>
</apply>
</apply>
</math>
</role>
</variable_ref>
</reaction>
</component>

<component name="reaction11">
  <variable name="Pi" public_interface="in" units="micromolar" />
  <variable name="Inosine" public_interface="in" units="micromolar" />
  <variable name="Ribose_1_phosphate" public_interface="in" units="micromolar" />
  <variable name="Hypoxanthine" public_interface="in" units="micromolar" />
  <variable name="Nucleoside_phosphorylase" public_interface="in" units="micromolar" />
  <variable name="delta_Pi_rxn11" public_interface="out" units="flux" />
  <variable name="delta_Inosine_rxn11" public_interface="out" units="flux" />
  <variable name="delta_Ribose_1_phosphate_rxn11" public_interface="out" units="flux" />
  <variable name="delta_Hypoxanthine_rxn11" public_interface="out" units="flux" />
  <variable name="km11" initial_value="1.0" units="micromolar" />
  <variable name="vmax11" initial_value="1.0" units="second_order_rate_constant" />
  <variable name="rate" units="flux" />
  <reaction reversible="no">
    <variable_ref variable="Pi">
      <role role="reactant" delta_variable="delta_Pi_rxn11" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Inosine">
      <role role="reactant" delta_variable="delta_Inosine_rxn11" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Ribose_1_phosphate">
      <role role="product" delta_variable="delta_Ribose_1_phosphate_rxn11" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Hypoxanthine">
      <role role="product" delta_variable="delta_Hypoxanthine_rxn11" stoichiometry="1" />
    </variable_ref>
    <variable_ref variable="Nucleoside_phosphorylase">
      <role role="catalyst" direction="forward" />
    </variable_ref>
    <variable_ref variable="rate">
      <role role="rate">
        <math xmlns="http://www.w3.org/1998/Math/MathML">
          <apply>
            <eq />
            <ci>rate</ci>
            <apply>
              <divide />
              <apply>
                <times />
                <ci>Pi</ci>
                <ci>Inosine</ci>
                <ci>vmax11</ci>
              </apply>
            <apply>
              <plus />
              <ci>km11</ci>
            </apply>
          </math>
        </role>
      </variable_ref>
    </reaction>
  </component>

```

```

        <ci>Pi</ci>
        <ci>Inosine</ci>
    </apply>
</apply>
</math>
</role>
</variable_ref>
</reaction>
</component>

<connection>
  <map_components component_1="AMP" component_2="reaction0" />
  <map_variables variable_1="AMP" variable_2="AMP" />
  <map_variables variable_1="delta_AMP_rxn0" variable_2="delta_AMP_rxn0" />
</connection>

<connection>
  <map_components component_1="H2O" component_2="reaction10" />
  <map_variables variable_1="H2O" variable_2="H2O" />
  <map_variables variable_1="delta_H2O_rxn10" variable_2="delta_H2O_rxn10" />
</connection>

<connection>
  <map_components component_1="H2O" component_2="reaction0" />
  <map_variables variable_1="H2O" variable_2="H2O" />
  <map_variables variable_1="delta_H2O_rxn0" variable_2="delta_H2O_rxn0" />
</connection>

<connection>
  <map_components component_1="H2O" component_2="reaction1" />
  <map_variables variable_1="H2O" variable_2="H2O" />
  <map_variables variable_1="delta_H2O_rxn1" variable_2="delta_H2O_rxn1" />
</connection>

<connection>
  <map_components component_1="H2O" component_2="reaction3" />
  <map_variables variable_1="H2O" variable_2="H2O" />
  <map_variables variable_1="delta_H2O_rxn3" variable_2="delta_H2O_rxn3" />
</connection>

<connection>
  <map_components component_1="H2O" component_2="reaction4" />
  <map_variables variable_1="H2O" variable_2="H2O" />
  <map_variables variable_1="delta_H2O_rxn4" variable_2="delta_H2O_rxn4" />
</connection>

<connection>
  <map_components component_1="H2O" component_2="reaction6" />
  <map_variables variable_1="H2O" variable_2="H2O" />
  <map_variables variable_1="delta_H2O_rxn6" variable_2="delta_H2O_rxn6" />
</connection>

<connection>
  <map_components component_1="H2O" component_2="reaction7" />
  <map_variables variable_1="H2O" variable_2="H2O" />
  <map_variables variable_1="delta_H2O_rxn7" variable_2="delta_H2O_rxn7" />
</connection>

```

```
<connection>
  <map_components component_1="H" component_2="reaction3" />
  <map_variables variable_1="H" variable_2="H" />
  <map_variables variable_1="delta_H_rxn3" variable_2="delta_H_rxn3" />
</connection>

<connection>
  <map_components component_1="H" component_2="reaction7" />
  <map_variables variable_1="H" variable_2="H" />
  <map_variables variable_1="delta_H_rxn7" variable_2="delta_H_rxn7" />
</connection>

<connection>
  <map_components component_1="H" component_2="reaction0" />
  <map_variables variable_1="H" variable_2="H" />
  <map_variables variable_1="delta_H_rxn0" variable_2="delta_H_rxn0" />
</connection>

<connection>
  <map_components component_1="H" component_2="reaction4" />
  <map_variables variable_1="H" variable_2="H" />
  <map_variables variable_1="delta_H_rxn4" variable_2="delta_H_rxn4" />
</connection>

<connection>
  <map_components component_1="H" component_2="reaction9" />
  <map_variables variable_1="H" variable_2="H" />
  <map_variables variable_1="delta_H_rxn9" variable_2="delta_H_rxn9" />
</connection>

<connection>
  <map_components component_1="NH4" component_2="reaction0" />
  <map_variables variable_1="NH4" variable_2="NH4" />
  <map_variables variable_1="delta_NH4_rxn0" variable_2="delta_NH4_rxn0" />
</connection>

<connection>
  <map_components component_1="NH4" component_2="reaction4" />
  <map_variables variable_1="NH4" variable_2="NH4" />
  <map_variables variable_1="delta_NH4_rxn4" variable_2="delta_NH4_rxn4" />
</connection>

<connection>
  <map_components component_1="Inosine_5_phosphate" component_2="reaction0" />
  <map_variables variable_1="Inosine_5_phosphate" variable_2="Inosine_5_phosphate" />
  <map_variables variable_1="delta_Inosine_5_phosphate_rxn0" variable_2="delta_Inosine_5_
</connection>

<connection>
  <map_components component_1="Inosine_5_phosphate" component_2="reaction1" />
  <map_variables variable_1="Inosine_5_phosphate" variable_2="Inosine_5_phosphate" />
  <map_variables variable_1="delta_Inosine_5_phosphate_rxn1" variable_2="delta_Inosine_5_
</connection>

<connection>
  <map_components component_1="Pi" component_2="reaction1" />
  <map_variables variable_1="Pi" variable_2="Pi" />
  <map_variables variable_1="delta_Pi_rxn1" variable_2="delta_Pi_rxn1" />
</connection>
```

```
<connection>
  <map_components component_1="Pi" component_2="reaction6" />
  <map_variables variable_1="Pi" variable_2="Pi" />
  <map_variables variable_1="delta_Pi_rxn6" variable_2="delta_Pi_rxn6" />
</connection>

<connection>
  <map_components component_1="Pi" component_2="reaction2" />
  <map_variables variable_1="Pi" variable_2="Pi" />
  <map_variables variable_1="delta_Pi_rxn2" variable_2="delta_Pi_rxn2" />
</connection>

<connection>
  <map_components component_1="Pi" component_2="reaction5" />
  <map_variables variable_1="Pi" variable_2="Pi" />
  <map_variables variable_1="delta_Pi_rxn5" variable_2="delta_Pi_rxn5" />
</connection>

<connection>
  <map_components component_1="Pi" component_2="reaction11" />
  <map_variables variable_1="Pi" variable_2="Pi" />
  <map_variables variable_1="delta_Pi_rxn11" variable_2="delta_Pi_rxn11" />
</connection>

<connection>
  <map_components component_1="Inosine" component_2="reaction1" />
  <map_variables variable_1="Inosine" variable_2="Inosine" />
  <map_variables variable_1="delta_Inosine_rxn1" variable_2="delta_Inosine_rxn1" />
</connection>

<connection>
  <map_components component_1="Inosine" component_2="reaction2" />
  <map_variables variable_1="Inosine" variable_2="Inosine" />
  <map_variables variable_1="delta_Inosine_rxn2" variable_2="delta_Inosine_rxn2" />
</connection>

<connection>
  <map_components component_1="Inosine" component_2="reaction11" />
  <map_variables variable_1="Inosine" variable_2="Inosine" />
  <map_variables variable_1="delta_Inosine_rxn11" variable_2="delta_Inosine_rxn11" />
</connection>

<connection>
  <map_components component_1="Ribose_1_phosphate" component_2="reaction2" />
  <map_variables variable_1="Ribose_1_phosphate" variable_2="Ribose_1_phosphate" />
  <map_variables variable_1="delta_Ribose_1_phosphate_rxn2" variable_2="delta_Ribose_1_phosphate_rxn2" />
</connection>

<connection>
  <map_components component_1="Ribose_1_phosphate" component_2="reaction5" />
  <map_variables variable_1="Ribose_1_phosphate" variable_2="Ribose_1_phosphate" />
  <map_variables variable_1="delta_Ribose_1_phosphate_rxn5" variable_2="delta_Ribose_1_phosphate_rxn5" />
</connection>

<connection>
  <map_components component_1="Ribose_1_phosphate" component_2="reaction11" />
  <map_variables variable_1="Ribose_1_phosphate" variable_2="Ribose_1_phosphate" />
  <map_variables variable_1="delta_Ribose_1_phosphate_rxn11" variable_2="delta_Ribose_1_phosphate_rxn11" />
</connection>
```

```
</connection>

<connection>
  <map_components component_1="Hypoxanthine" component_2="reaction2" />
  <map_variables variable_1="Hypoxanthine" variable_2="Hypoxanthine" />
  <map_variables variable_1="delta_Hypoxanthine_rxn2" variable_2="delta_Hypoxanthine_rxn2" />
</connection>

<connection>
  <map_components component_1="Hypoxanthine" component_2="reaction11" />
  <map_variables variable_1="Hypoxanthine" variable_2="Hypoxanthine" />
  <map_variables variable_1="delta_Hypoxanthine_rxn11" variable_2="delta_Hypoxanthine_rxn11" />
</connection>

<connection>
  <map_components component_1="Xanthine" component_2="reaction3" />
  <map_variables variable_1="Xanthine" variable_2="Xanthine" />
  <map_variables variable_1="delta_Xanthine_rxn3" variable_2="delta_Xanthine_rxn3" />
</connection>

<connection>
  <map_components component_1="Xanthine" component_2="reaction4" />
  <map_variables variable_1="Xanthine" variable_2="Xanthine" />
  <map_variables variable_1="delta_Xanthine_rxn4" variable_2="delta_Xanthine_rxn4" />
</connection>

<connection>
  <map_components component_1="Xanthine" component_2="reaction7" />
  <map_variables variable_1="Xanthine" variable_2="Xanthine" />
  <map_variables variable_1="delta_Xanthine_rxn7" variable_2="delta_Xanthine_rxn7" />
</connection>

<connection>
  <map_components component_1="O2" component_2="reaction9" />
  <map_variables variable_1="O2" variable_2="O2" />
  <map_variables variable_1="delta_O2_rxn9" variable_2="delta_O2_rxn9" />
</connection>

<connection>
  <map_components component_1="O2" component_2="reaction10" />
  <map_variables variable_1="O2" variable_2="O2" />
  <map_variables variable_1="delta_O2_rxn10" variable_2="delta_O2_rxn10" />
</connection>

<connection>
  <map_components component_1="O2" component_2="reaction3" />
  <map_variables variable_1="O2" variable_2="O2" />
  <map_variables variable_1="delta_O2_rxn3" variable_2="delta_O2_rxn3" />
</connection>

<connection>
  <map_components component_1="O2" component_2="reaction7" />
  <map_variables variable_1="O2" variable_2="O2" />
  <map_variables variable_1="delta_O2_rxn7" variable_2="delta_O2_rxn7" />
</connection>

<connection>
  <map_components component_1="O2_free_radical" component_2="reaction3" />
  <map_variables variable_1="O2_free_radical" variable_2="O2_free_radical" />
</connection>
```

```
<map_variables variable_1="delta_O2_free_radical_rxn3" variable_2="delta_O2_free_radical_rxn3" />
</connection>

<connection>
  <map_components component_1="O2_free_radical" component_2="reaction7" />
  <map_variables variable_1="O2_free_radical" variable_2="O2_free_radical" />
  <map_variables variable_1="delta_O2_free_radical_rxn7" variable_2="delta_O2_free_radical_rxn7" />
</connection>

<connection>
  <map_components component_1="O2_free_radical" component_2="reaction8" />
  <map_variables variable_1="O2_free_radical" variable_2="O2_free_radical" />
  <map_variables variable_1="delta_O2_free_radical_rxn8" variable_2="delta_O2_free_radical_rxn8" />
</connection>

<connection>
  <map_components component_1="O2_free_radical" component_2="reaction9" />
  <map_variables variable_1="O2_free_radical" variable_2="O2_free_radical" />
  <map_variables variable_1="delta_O2_free_radical_rxn9" variable_2="delta_O2_free_radical_rxn9" />
</connection>

<connection>
  <map_components component_1="Guanine" component_2="reaction5" />
  <map_variables variable_1="Guanine" variable_2="Guanine" />
  <map_variables variable_1="delta_Guanine_rxn5" variable_2="delta_Guanine_rxn5" />
</connection>

<connection>
  <map_components component_1="Guanine" component_2="reaction4" />
  <map_variables variable_1="Guanine" variable_2="Guanine" />
  <map_variables variable_1="delta_Guanine_rxn4" variable_2="delta_Guanine_rxn4" />
</connection>

<connection>
  <map_components component_1="Guanosine" component_2="reaction6" />
  <map_variables variable_1="Guanosine" variable_2="Guanosine" />
  <map_variables variable_1="delta_Guanosine_rxn6" variable_2="delta_Guanosine_rxn6" />
</connection>

<connection>
  <map_components component_1="Guanosine" component_2="reaction5" />
  <map_variables variable_1="Guanosine" variable_2="Guanosine" />
  <map_variables variable_1="delta_Guanosine_rxn5" variable_2="delta_Guanosine_rxn5" />
</connection>

<connection>
  <map_components component_1="GMP" component_2="reaction6" />
  <map_variables variable_1="GMP" variable_2="GMP" />
  <map_variables variable_1="delta_GMP_rxn6" variable_2="delta_GMP_rxn6" />
</connection>

<connection>
  <map_components component_1="Urate" component_2="reaction7" />
  <map_variables variable_1="Urate" variable_2="Urate" />
  <map_variables variable_1="delta_Urate_rxn7" variable_2="delta_Urate_rxn7" />
</connection>

<connection>
  <map_components component_1="Urate" component_2="reaction8" />
```

```
<map_variables variable_1="Urate" variable_2="Urate" />
<map_variables variable_1="delta_Urate_rxn8" variable_2="delta_Urate_rxn8" />
</connection>

<connection>
  <map_components component_1="CO2" component_2="reaction8" />
  <map_variables variable_1="CO2" variable_2="CO2" />
  <map_variables variable_1="delta_CO2_rxn8" variable_2="delta_CO2_rxn8" />
</connection>

<connection>
  <map_components component_1="Allantoin" component_2="reaction8" />
  <map_variables variable_1="Allantoin" variable_2="Allantoin" />
  <map_variables variable_1="delta_Allantoin_rxn8" variable_2="delta_Allantoin_rxn8" />
</connection>

<connection>
  <map_components component_1="H2O2" component_2="reaction9" />
  <map_variables variable_1="H2O2" variable_2="H2O2" />
  <map_variables variable_1="delta_H2O2_rxn9" variable_2="delta_H2O2_rxn9" />
</connection>

<connection>
  <map_components component_1="H2O2" component_2="reaction10" />
  <map_variables variable_1="H2O2" variable_2="H2O2" />
  <map_variables variable_1="delta_H2O2_rxn10" variable_2="delta_H2O2_rxn10" />
</connection>

<connection>
  <map_components component_1="Catalase" component_2="reaction10" />
  <map_variables variable_1="Catalase" variable_2="Catalase" />
</connection>

<connection>
  <map_components component_1="AMP" component_2="global_variables" />
  <map_variables variable_1="time" variable_2="time" />
</connection>

<connection>
  <map_components component_1="H2O" component_2="global_variables" />
  <map_variables variable_1="time" variable_2="time" />
</connection>

<connection>
  <map_components component_1="H" component_2="global_variables" />
  <map_variables variable_1="time" variable_2="time" />
</connection>

<connection>
  <map_components component_1="NH4" component_2="global_variables" />
  <map_variables variable_1="time" variable_2="time" />
</connection>

<connection>
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<connection>
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<connection>
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<connection>
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