

PyCoMo_basics

July 6, 2023

1 PyCoMo Basics

PyCoMo is a **P**ython **C**ommunity metabolic **M**odelling package. In this tutorial, the core features will be presented.

The expected runtime for this notebook is approximately 5 minutes. *## Setting up PyCoMo ##*
Clone the package from github. Next, we are going to import all the packages we need in this tutorial.

```
[1]: from pathlib import Path
import sys
import cobra
import os
```

1.0.1 Importing PyCoMo

As PyCoMo is currently only available as a local package, the direct path to the package directory needs to be used on import.

```
[2]: path_root = "../pycomo" # Change path according to your PyCoMo location
sys.path.append(str(path_root))
import pycomo as pycomo
```

Now we will check if PyCoMo was loaded correctly. For this, we will run the help function on the PyCoMo package.

```
[ ]: help(pycomo)
```

1.1 Creating a Community Model

The creation of a community model consists of 3 steps: 1. Loading the member models 2. Preparing the member models for merging 3. Creating a community model *### Loading the member models ###*
The community model creation process starts with models of the individual members. Note that the quality of the community model heavily depends on the quality of the member models!

In this tutorial we are using metabolic models from the AGORA collection. The models were retrieved from www.vmh.life, and are stored in the data folder of the repository. The selection of models and the resulting community represents a cystic fibrosis airway community, as done by Henson et al. ([www.doi.org/10.1128/mSystems.00026-19](https://doi.org/10.1128/mSystems.00026-19))

```
[4]: test_model_dir = "../data/use_case/henson"
      named_models = pycomo.load_named_models_from_dir(test_model_dir)
```

The models and file names were extracted and stored in `named_models`. Let's check the contents:

```
[5]: named_models
```

```
[5]: {'Achromobacter_xylosoxidans_NBRC_15126': <Model
Achromobacter_xylosoxidans_NBRC_15126 at 0x158bc135730>,
      'Actinomyces_naeslundii_str_Howell_279': <Model
Actinomyces_naeslundii_str_Howell_279 at 0x158c509e070>,
      'Burkholderia_cepacia_GG4': <Model Burkholderia_cepacia_GG4 at 0x158c5825340>,
      'Escherichia_coli_str_K_12_substr_MG1655': <Model
Escherichia_coli_str_K_12_substr_MG1655 at 0x158c76c85b0>,
      'Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586': <Model
Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586 at 0x158c94ca730>,
      'Gemella_haemolysans_ATCC_10379': <Model Gemella_haemolysans_ATCC_10379 at
0x158c98dce50>,
      'Granulicatella_adiacens_ATCC_49175': <Model Granulicatella_adiacens_ATCC_49175
at 0x158c9f6c730>,
      'Haemophilus_influenzae_R2846': <Model Haemophilus_influenzae_R2846 at
0x158ca5f73d0>,
      'Neisseria_flavescens_SK114': <Model Neisseria_flavescens_SK114 at
0x158cae89b50>,
      'Porphyromonas_endodontalis_ATCC_35406': <Model
Porphyromonas_endodontalis_ATCC_35406 at 0x158cb6a5430>,
      'Prevotella_melaninogenica_ATCC_25845': <Model
Prevotella_melaninogenica_ATCC_25845 at 0x158cbbd6580>,
      'Pseudomonas_aeruginosa_NCGM2_S1': <Model Pseudomonas_aeruginosa_NCGM2_S1 at
0x158cc2c9b20>,
      'Ralstonia_sp_5_7_47FAA': <Model Ralstonia_sp_5_7_47FAA at 0x158cba6c6a0>,
      'Rothia_mucilaginosa_DY_18': <Model Rothia_mucilaginosa_DY_18 at
0x158cd9e1220>,
      'Staphylococcus_aureus_subsp_aureus_USA300_FPR3757': <Model
Staphylococcus_aureus_subsp_aureus_USA300_FPR3757 at 0x158cdf45cd0>,
      'Streptococcus_sanguinis_SK36': <Model Streptococcus_sanguinis_SK36 at
0x158ce9b6d30>,
      'Veillonella_atypica_ACS_049_V_Sch6': <Model Veillonella_atypica_ACS_049_V_Sch6
at 0x158cf052a60>}
```

1.1.1 Preparing the models for merging

With the models loaded, the next step is preparing them for merging. This is done by creating `SingleOrganismModel` objects. Using them, the models will be formatted for compliance with the SBML format. Further, an exchange compartment will be generated under the name *exchg*.

One of the requirements for a community metabolic model is a common biomass function. To construct it, PyCoMo requires the biomass of each member represented as a single metabolite.

This biomass metabolite ID can be specified when constructing the SingleOrganismModel objects. However, it can also be found or generated automatically, by setting the biomass reaction as the objective of the model. Let's check if the biomass function is the objective in all the models

```
[6]: for model in named_models.values():  
      print(model.objective)
```

```
Maximize  
1.0*biomass489 - 1.0*biomass489_reverse_62d1a  
Maximize  
1.0*biomass492 - 1.0*biomass492_reverse_bc961  
Maximize  
1.0*biomass479 - 1.0*biomass479_reverse_1d1b2  
Maximize  
1.0*biomass525 - 1.0*biomass525_reverse_5c178  
Maximize  
1.0*biomass237 - 1.0*biomass237_reverse_f032e  
Maximize  
1.0*biomass027 - 1.0*biomass027_reverse_af8dc  
Maximize  
1.0*biomass091 - 1.0*biomass091_reverse_7b6db  
Maximize  
1.0*biomass252 - 1.0*biomass252_reverse_f6948  
Maximize  
1.0*biomass339 - 1.0*biomass339_reverse_45ed6  
Maximize  
1.0*biomass326 - 1.0*biomass326_reverse_02060  
Maximize  
1.0*biomass276 - 1.0*biomass276_reverse_7f92e  
Maximize  
1.0*biomass345 - 1.0*biomass345_reverse_e128f  
Maximize  
1.0*biomass525 - 1.0*biomass525_reverse_5c178  
Maximize  
1.0*biomass429 - 1.0*biomass429_reverse_9caa0  
Maximize  
1.0*biomass042 - 1.0*biomass042_reverse_2a02b  
Maximize  
1.0*biomass164 - 1.0*biomass164_reverse_ca493  
Maximize  
1.0*biomass116 - 1.0*biomass116_reverse_02324
```

With the objective being the biomass function in all models, the biomass metabolite does not need to be specified.

```
[7]: single_org_models = []  
for name, model in named_models.items():  
    print(name)
```

```
single_org_model = pycomo.SingleOrganismModel(model, name)
single_org_models.append(single_org_model)
```

```
Achromobacter_xylosoxidans_NBRC_15126
Actinomyces_naeslundii_str_Howell_279
Burkholderia_cepacia_GG4
Escherichia_coli_str_K_12_substr_MG1655
Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586
Gemella_haemolysans_ATCC_10379
Granulicatella_adiazens_ATCC_49175
Haemophilus_influenzae_R2846
Neisseria_flavescens_SK114
Porphyromonas_endodontalis_ATCC_35406
Prevotella_melaninogenica_ATCC_25845
Pseudomonas_aeruginosa_NCGM2_S1
Ralstonia_sp_5_7_47FAA
Rothia_mucilaginosa_DY_18
Staphylococcus_aureus_subsp_aureus_USA300_FPR3757
Streptococcus_sanguinis_SK36
Veillonella_atypica_ACS_049_V_Sch6
```

1.1.2 Creating a community model

With the member models prepared, the community model can be generated. The first step is to create a CommunityModel objects from the member models. The matching of the exchange metabolites can be achieved in two ways: matching via identical metabolite IDs, or via annotation fields. In this tutorial and as all the models come from the same source, matching via identical metabolite IDs will be used.

```
[8]: community_name = "henson_community_model"
     com_model_obj = pycomo.CommunityModel(single_org_models, community_name)
```

The cobra model of the community will generated the first time it is needed. We can enforce this now, by calling it via .community_model

```
[9]: com_model_obj.community_model
```

```
No constrained community model set yet. Using the unconstrained model instead.
No unconstrained community model generated yet. Generating now:
Note: no products in the objective function, adding biomass to it.
Note: no products in the objective function, adding biomass to it.
```

```
Ignoring reaction 'EX_4abz_exchg' since it already exists.
Ignoring reaction 'EX_Lcyst_exchg' since it already exists.
Ignoring reaction 'EX_ac_exchg' since it already exists.
Ignoring reaction 'EX_acgam_exchg' since it already exists.
Ignoring reaction 'EX_ala_L_exchg' since it already exists.
Ignoring reaction 'EX_alaasp_exchg' since it already exists.
Ignoring reaction 'EX_alagln_exchg' since it already exists.
```

Ignoring reaction 'EX_alaglu_exchg' since it already exists.
Ignoring reaction 'EX_alagly_exchg' since it already exists.
Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_alltn_exchg' since it already exists.
Ignoring reaction 'EX_arab_L_exchg' since it already exists.
Ignoring reaction 'EX_arbt_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_btn_exchg' since it already exists.
Ignoring reaction 'EX_butso3_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_chol_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_ethso3_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_fol_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyb_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.

Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gthrd_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h2s_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hexs_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_isetac_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mops_exchg' since it already exists.
Ignoring reaction 'EX_mqn7_exchg' since it already exists.
Ignoring reaction 'EX_mso3_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_ppi_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_rib_D_exchg' since it already exists.

Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_sulfac_exchg' since it already exists.
Ignoring reaction 'EX_taur_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_ttdca_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xyl_D_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglN. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite ethso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite isetac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance

in all models!

WARNING: no annotation overlap found for matching metabolite mso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mops. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sulfac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hexs. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite h2s. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 4abz. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite butso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance

in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_26dap_M_exchg' since it already exists.

Ignoring reaction 'EX_2hyoxplac_exchg' since it already exists.

Ignoring reaction 'EX_34dhpha_exchg' since it already exists.

Ignoring reaction 'EX_34dhphe_exchg' since it already exists.

Ignoring reaction 'EX_3mop_exchg' since it already exists.

Ignoring reaction 'EX_4abz_exchg' since it already exists.

Ignoring reaction 'EX_5htrp_exchg' since it already exists.

Ignoring reaction 'EX_Lcyst_exchg' since it already exists.

Ignoring reaction 'EX_Lkynr_exchg' since it already exists.

Ignoring reaction 'EX_ac_exchg' since it already exists.

Ignoring reaction 'EX_acac_exchg' since it already exists.

Ignoring reaction 'EX_acgam_exchg' since it already exists.

Ignoring reaction 'EX_adocbl_exchg' since it already exists.

Ignoring reaction 'EX_akg_exchg' since it already exists.

Ignoring reaction 'EX_ala_D_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.

Ignoring reaction 'EX_alaasp_exchg' since it already exists.

Ignoring reaction 'EX_alagln_exchg' since it already exists.

Ignoring reaction 'EX_alaglu_exchg' since it already exists.
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WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

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WARNING: no annotation overlap found for matching metabolite alagln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite ethso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

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WARNING: no annotation overlap found for matching metabolite mso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite galctn_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make

sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mops. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sulfac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hexs. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite h2s. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite arab_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 4abz. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite butso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make

sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn1. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Ignoring reaction 'EX_arab_L_exchg' since it already exists.

Ignoring reaction 'EX_arbt_exchg' since it already exists.

Ignoring reaction 'EX_arg_L_exchg' since it already exists.

Ignoring reaction 'EX_asn_L_exchg' since it already exists.

Ignoring reaction 'EX_asp_L_exchg' since it already exists.

Ignoring reaction 'EX_bhb_exchg' since it already exists.

Ignoring reaction 'EX_but_exchg' since it already exists.

Ignoring reaction 'EX_butso3_exchg' since it already exists.

Ignoring reaction 'EX_ca2_exchg' since it already exists.

Ignoring reaction 'EX_cbl1_exchg' since it already exists.

Ignoring reaction 'EX_cbl2_exchg' since it already exists.

Ignoring reaction 'EX_cd2_exchg' since it already exists.

Ignoring reaction 'EX_cgly_exchg' since it already exists.

Ignoring reaction 'EX_cit_exchg' since it already exists.

Ignoring reaction 'EX_cl_exchg' since it already exists.

Ignoring reaction 'EX_co2_exchg' since it already exists.

Ignoring reaction 'EX_cobalt2_exchg' since it already exists.

Ignoring reaction 'EX_csn_exchg' since it already exists.

Ignoring reaction 'EX_cu2_exchg' since it already exists.

Ignoring reaction 'EX_cys_L_exchg' since it already exists.

Ignoring reaction 'EX_dopa_exchg' since it already exists.

Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_ethso3_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_fol_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_fum_exchg' since it already exists.
Ignoring reaction 'EX_galctn_D_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyb_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gthrd_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h2s_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hexs_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hista_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_ind3ac_exchg' since it already exists.
Ignoring reaction 'EX_isetac_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_mal_L_exchg' since it already exists.

Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_malthx_exchg' since it already exists.
Ignoring reaction 'EX_malttr_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mops_exchg' since it already exists.
Ignoring reaction 'EX_mso3_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_pac_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_ppi_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_rib_D_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spmd_exchg' since it already exists.
Ignoring reaction 'EX_srtm_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_sulfac_exchg' since it already exists.
Ignoring reaction 'EX_taur_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.

Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_trypta_exchg' since it already exists.
Ignoring reaction 'EX_tsul_exchg' since it already exists.
Ignoring reaction 'EX_tym_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_urea_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xan_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_12ppd_S_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite ethso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite tma. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite galct_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite isetac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make

sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite dhcinm. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite indole. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite galctn_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mops. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sulfac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hexs. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 15dap. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mantr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite h2s. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 3hpppn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite aso4. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite dhpppn. Please make

sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite tmao. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite butso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2ddgln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite aso3. Please make

sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite galur. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Ignoring reaction 'EX_15dap_exchg' since it already exists.
Ignoring reaction 'EX_2ddgln_exchg' since it already exists.
Ignoring reaction 'EX_3hpppn_exchg' since it already exists.
Ignoring reaction 'EX_4hbx_exchg' since it already exists.
Ignoring reaction 'EX_Lcyst_exchg' since it already exists.
Ignoring reaction 'EX_ac_exchg' since it already exists.
Ignoring reaction 'EX_acac_exchg' since it already exists.
Ignoring reaction 'EX_acald_exchg' since it already exists.
Ignoring reaction 'EX_acgam_exchg' since it already exists.
Ignoring reaction 'EX_adn_exchg' since it already exists.
Ignoring reaction 'EX_adocbl_exchg' since it already exists.
Ignoring reaction 'EX_akg_exchg' since it already exists.
Ignoring reaction 'EX_ala_D_exchg' since it already exists.
Ignoring reaction 'EX_ala_L_exchg' since it already exists.
Ignoring reaction 'EX_alaasp_exchg' since it already exists.
Ignoring reaction 'EX_alagln_exchg' since it already exists.
Ignoring reaction 'EX_alaglu_exchg' since it already exists.
Ignoring reaction 'EX_alagly_exchg' since it already exists.
Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_alltn_exchg' since it already exists.
Ignoring reaction 'EX_arab_L_exchg' since it already exists.
Ignoring reaction 'EX_arbt_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_aso3_exchg' since it already exists.
Ignoring reaction 'EX_aso4_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_btn_exchg' since it already exists.
Ignoring reaction 'EX_but_exchg' since it already exists.
Ignoring reaction 'EX_butso3_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.

Ignoring reaction 'EX_cbl1_exchg' since it already exists.
Ignoring reaction 'EX_cbl2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_chol_exchg' since it already exists.
Ignoring reaction 'EX_cit_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cynt_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_cytd_exchg' since it already exists.
Ignoring reaction 'EX_dad_2_exchg' since it already exists.
Ignoring reaction 'EX_dcyt_exchg' since it already exists.
Ignoring reaction 'EX_ddca_exchg' since it already exists.
Ignoring reaction 'EX_dhcinm_exchg' since it already exists.
Ignoring reaction 'EX_dhpppn_exchg' since it already exists.
Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_etha_exchg' since it already exists.
Ignoring reaction 'EX_ethso3_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_fuc_L_exchg' since it already exists.
Ignoring reaction 'EX_fum_exchg' since it already exists.
Ignoring reaction 'EX_galct_D_exchg' since it already exists.
Ignoring reaction 'EX_galctn_D_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_galur_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_glcn_exchg' since it already exists.
Ignoring reaction 'EX_glcr_exchg' since it already exists.
Ignoring reaction 'EX_glcur_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyb_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glyclt_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.

Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h2s_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hdca_exchg' since it already exists.
Ignoring reaction 'EX_hexs_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_indole_exchg' since it already exists.
Ignoring reaction 'EX_isetac_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_lcts_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_mal_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_malthx_exchg' since it already exists.
Ignoring reaction 'EX_malttr_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_mantr_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mops_exchg' since it already exists.
Ignoring reaction 'EX_mso3_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_pac_exchg' since it already exists.

Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_ppi_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_rib_D_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spm_d_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_sulfac_exchg' since it already exists.
Ignoring reaction 'EX_taur_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_thymd_exchg' since it already exists.
Ignoring reaction 'EX_tma_exchg' since it already exists.
Ignoring reaction 'EX_tmao_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_tsul_exchg' since it already exists.
Ignoring reaction 'EX_ttdca_exchg' since it already exists.
Ignoring reaction 'EX_tym_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_urea_exchg' since it already exists.
Ignoring reaction 'EX_uri_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xan_exchg' since it already exists.
Ignoring reaction 'EX_xyl_D_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_15dap_exchg' since it already exists.
Ignoring reaction 'EX_2dmmq8_exchg' since it already exists.
Ignoring reaction 'EX_2obut_exchg' since it already exists.
Ignoring reaction 'EX_3mop_exchg' since it already exists.
Ignoring reaction 'EX_ac_exchg' since it already exists.
Ignoring reaction 'EX_acac_exchg' since it already exists.
Ignoring reaction 'EX_acgam_exchg' since it already exists.

Ignoring reaction 'EX_adocbl_exchg' since it already exists.
Ignoring reaction 'EX_ala_L_exchg' since it already exists.
Ignoring reaction 'EX_alaasp_exchg' since it already exists.
Ignoring reaction 'EX_alagln_exchg' since it already exists.
Ignoring reaction 'EX_alaglu_exchg' since it already exists.
Ignoring reaction 'EX_alagly_exchg' since it already exists.
Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_arbt_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_bhb_exchg' since it already exists.
Ignoring reaction 'EX_btn_exchg' since it already exists.
Ignoring reaction 'EX_but_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cbl1_exchg' since it already exists.
Ignoring reaction 'EX_cbl2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_cytd_exchg' since it already exists.
Ignoring reaction 'EX_dad_2_exchg' since it already exists.
Ignoring reaction 'EX_dgsn_exchg' since it already exists.
Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_etha_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_fol_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_gal_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.

Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h2s_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_indole_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mqn8_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_pnto_R_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.

Ignoring reaction 'EX_q8_exchg' since it already exists.
Ignoring reaction 'EX_rib_D_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spmd_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_thymd_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_urea_exchg' since it already exists.
Ignoring reaction 'EX_uri_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglN. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite indole. Please make sure that the metabolite with this ID is indeed representing the same substance

in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 15dap. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite h2s. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2dmmq8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite q8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance

in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_26dap_M_exchg' since it already exists.

Ignoring reaction 'EX_2dmmq8_exchg' since it already exists.

Ignoring reaction 'EX_34dhphe_exchg' since it already exists.

Ignoring reaction 'EX_3mop_exchg' since it already exists.

Ignoring reaction 'EX_5htrp_exchg' since it already exists.

Ignoring reaction 'EX_ac_exchg' since it already exists.

Ignoring reaction 'EX_acald_exchg' since it already exists.

Ignoring reaction 'EX_acgam_exchg' since it already exists.

Ignoring reaction 'EX_ade_exchg' since it already exists.

Ignoring reaction 'EX_ala_D_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.

Ignoring reaction 'EX_alaasp_exchg' since it already exists.

Ignoring reaction 'EX_alaglu_exchg' since it already exists.

Ignoring reaction 'EX_alagly_exchg' since it already exists.

Ignoring reaction 'EX_alahis_exchg' since it already exists.

Ignoring reaction 'EX_alaleu_exchg' since it already exists.

Ignoring reaction 'EX_alathr_exchg' since it already exists.

Ignoring reaction 'EX_arab_L_exchg' since it already exists.

Ignoring reaction 'EX_arbt_exchg' since it already exists.

Ignoring reaction 'EX_arg_L_exchg' since it already exists.

Ignoring reaction 'EX_asn_L_exchg' since it already exists.

Ignoring reaction 'EX_asp_L_exchg' since it already exists.

Ignoring reaction 'EX_ca2_exchg' since it already exists.

Ignoring reaction 'EX_cd2_exchg' since it already exists.

Ignoring reaction 'EX_cgly_exchg' since it already exists.

Ignoring reaction 'EX_cl_exchg' since it already exists.

Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_dcyt_exchg' since it already exists.
Ignoring reaction 'EX_dopa_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_fol_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_glcN_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyb_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hista_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_malthx_exchg' since it already exists.
Ignoring reaction 'EX_malttr_exchg' since it already exists.

Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_melib_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mqn8_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_pnto_R_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_pppn_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_q8_exchg' since it already exists.
Ignoring reaction 'EX_raffin_exchg' since it already exists.
Ignoring reaction 'EX_rib_D_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spmd_exchg' since it already exists.
Ignoring reaction 'EX_srtm_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_trypta_exchg' since it already exists.
Ignoring reaction 'EX_tym_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.

Ignoring reaction 'EX_xan_exchg' since it already exists.

Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglN. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite melib. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite raffin. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pppn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2dmmq8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite q8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn1. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_12dgr180_exchg' since it already exists.
Ignoring reaction 'EX_26dap_M_exchg' since it already exists.
Ignoring reaction 'EX_2ddgln_exchg' since it already exists.
Ignoring reaction 'EX_2dmmq8_exchg' since it already exists.
Ignoring reaction 'EX_2obut_exchg' since it already exists.
Ignoring reaction 'EX_3mop_exchg' since it already exists.
Ignoring reaction 'EX_4hbm_exchg' since it already exists.
Ignoring reaction 'EX_ac_exchg' since it already exists.
Ignoring reaction 'EX_acald_exchg' since it already exists.
Ignoring reaction 'EX_acgam_exchg' since it already exists.
Ignoring reaction 'EX_ade_exchg' since it already exists.
Ignoring reaction 'EX_ala_L_exchg' since it already exists.
Ignoring reaction 'EX_alaasp_exchg' since it already exists.
Ignoring reaction 'EX_alagln_exchg' since it already exists.
Ignoring reaction 'EX_alaglu_exchg' since it already exists.
Ignoring reaction 'EX_alagly_exchg' since it already exists.
Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_amp_exchg' since it already exists.
Ignoring reaction 'EX_arab_L_exchg' since it already exists.
Ignoring reaction 'EX_arbt_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_cytd_exchg' since it already exists.
Ignoring reaction 'EX_dad_2_exchg' since it already exists.
Ignoring reaction 'EX_dcyt_exchg' since it already exists.
Ignoring reaction 'EX_dgsn_exchg' since it already exists.
Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_etoh_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_fol_exchg' since it already exists.

Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mqn8_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.

Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_pnto_R_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_q8_exchg' since it already exists.
Ignoring reaction 'EX_rib_D_exchg' since it already exists.
Ignoring reaction 'EX_ribflv_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spm_d_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_thymd_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_uri_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xan_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 12dgr180. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2dmmq8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite q8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2ddgln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_26dap_M_exchg' since it already exists.

Ignoring reaction 'EX_34dhphe_exchg' since it already exists.

Ignoring reaction 'EX_4abz_exchg' since it already exists.

Ignoring reaction 'EX_4hbx_exchg' since it already exists.

Ignoring reaction 'EX_5htrp_exchg' since it already exists.

Ignoring reaction 'EX_ac_exchg' since it already exists.

Ignoring reaction 'EX_acald_exchg' since it already exists.

Ignoring reaction 'EX_acgam_exchg' since it already exists.

Ignoring reaction 'EX_acnam_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.

Ignoring reaction 'EX_alaasp_exchg' since it already exists.

Ignoring reaction 'EX_alagln_exchg' since it already exists.

Ignoring reaction 'EX_alaglu_exchg' since it already exists.

Ignoring reaction 'EX_alagly_exchg' since it already exists.

Ignoring reaction 'EX_alahis_exchg' since it already exists.

Ignoring reaction 'EX_alaleu_exchg' since it already exists.

Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_arbt_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_chol_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_dcyt_exchg' since it already exists.
Ignoring reaction 'EX_dms_exchg' since it already exists.
Ignoring reaction 'EX_dmsO_exchg' since it already exists.
Ignoring reaction 'EX_dopa_exchg' since it already exists.
Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_fecrm_exchg' since it already exists.
Ignoring reaction 'EX_fol_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_fum_exchg' since it already exists.
Ignoring reaction 'EX_gal_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.

Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hdca_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hista_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_mal_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_nmn_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_pnto_R_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_ppi_exchg' since it already exists.
Ignoring reaction 'EX_pppn_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_rib_D_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.

Ignoring reaction 'EX_spmd_exchg' since it already exists.
Ignoring reaction 'EX_srtm_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_tma_exchg' since it already exists.
Ignoring reaction 'EX_tmao_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_trypta_exchg' since it already exists.
Ignoring reaction 'EX_ttdca_exchg' since it already exists.
Ignoring reaction 'EX_tym_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xyl_D_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglN. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite tma. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance

in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pppn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite tmao. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 4abz. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite dmso. Please make sure that the metabolite with this ID is indeed representing the same substance

in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite dms. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite fecrm. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite n2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please

make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite n2o. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite h2s. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2dmmq8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite q8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make

sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Ignoring reaction 'EX_26dap_M_exchg' since it already exists.

Ignoring reaction 'EX_2dmmq8_exchg' since it already exists.

Ignoring reaction 'EX_2obut_exchg' since it already exists.

Ignoring reaction 'EX_34dhphe_exchg' since it already exists.

Ignoring reaction 'EX_5htrp_exchg' since it already exists.

Ignoring reaction 'EX_ac_exchg' since it already exists.

Ignoring reaction 'EX_acald_exchg' since it already exists.

Ignoring reaction 'EX_acgam_exchg' since it already exists.

Ignoring reaction 'EX_ade_exchg' since it already exists.

Ignoring reaction 'EX_adn_exchg' since it already exists.

Ignoring reaction 'EX_akg_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.

Ignoring reaction 'EX_alaasp_exchg' since it already exists.

Ignoring reaction 'EX_alagln_exchg' since it already exists.

Ignoring reaction 'EX_alaglu_exchg' since it already exists.

Ignoring reaction 'EX_alagly_exchg' since it already exists.

Ignoring reaction 'EX_alahis_exchg' since it already exists.

Ignoring reaction 'EX_alaleu_exchg' since it already exists.

Ignoring reaction 'EX_alathr_exchg' since it already exists.

Ignoring reaction 'EX_arbt_exchg' since it already exists.

Ignoring reaction 'EX_arg_L_exchg' since it already exists.

Ignoring reaction 'EX_asn_L_exchg' since it already exists.

Ignoring reaction 'EX_asp_L_exchg' since it already exists.

Ignoring reaction 'EX_ca2_exchg' since it already exists.

Ignoring reaction 'EX_cd2_exchg' since it already exists.

Ignoring reaction 'EX_cgly_exchg' since it already exists.

Ignoring reaction 'EX_chol_exchg' since it already exists.

Ignoring reaction 'EX_cit_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_cytd_exchg' since it already exists.
Ignoring reaction 'EX_dad_2_exchg' since it already exists.
Ignoring reaction 'EX_dgsn_exchg' since it already exists.
Ignoring reaction 'EX_dopa_exchg' since it already exists.
Ignoring reaction 'EX_etoh_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_fum_exchg' since it already exists.
Ignoring reaction 'EX_gal_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glyclt_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gthrd_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h2s_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hdca_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hista_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.

Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_mal_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mqn8_exchg' since it already exists.
Ignoring reaction 'EX_n2_exchg' since it already exists.
Ignoring reaction 'EX_n2o_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_ppi_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_q8_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spm_d_exchg' since it already exists.
Ignoring reaction 'EX_srt_n_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_taur_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.

Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_thymd_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_trypta_exchg' since it already exists.
Ignoring reaction 'EX_tsul_exchg' since it already exists.
Ignoring reaction 'EX_ttdca_exchg' since it already exists.
Ignoring reaction 'EX_tym_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_uri_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xan_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_26dap_M_exchg' since it already exists.
Ignoring reaction 'EX_2dmmq8_exchg' since it already exists.
Ignoring reaction 'EX_2obut_exchg' since it already exists.
Ignoring reaction 'EX_ac_exchg' since it already exists.
Ignoring reaction 'EX_acald_exchg' since it already exists.
Ignoring reaction 'EX_ade_exchg' since it already exists.
Ignoring reaction 'EX_adn_exchg' since it already exists.
Ignoring reaction 'EX_adocbl_exchg' since it already exists.
Ignoring reaction 'EX_ala_L_exchg' since it already exists.
Ignoring reaction 'EX_alaasp_exchg' since it already exists.
Ignoring reaction 'EX_alagln_exchg' since it already exists.
Ignoring reaction 'EX_alaglu_exchg' since it already exists.
Ignoring reaction 'EX_alagly_exchg' since it already exists.
Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_amp_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_but_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cbl1_exchg' since it already exists.
Ignoring reaction 'EX_cbl2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_cro4_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.

Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_cytd_exchg' since it already exists.
Ignoring reaction 'EX_dad_2_exchg' since it already exists.
Ignoring reaction 'EX_dcyt_exchg' since it already exists.
Ignoring reaction 'EX_dgsn_exchg' since it already exists.
Ignoring reaction 'EX_din_exchg' since it already exists.
Ignoring reaction 'EX_duri_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyclt_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gsn_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_indole_exchg' since it already exists.
Ignoring reaction 'EX_ins_exchg' since it already exists.
Ignoring reaction 'EX_isobut_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mqn8_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.

Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_pnto_R_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_q8_exchg' since it already exists.
Ignoring reaction 'EX_ribflv_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spm_d_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_thym_d_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_ttdca_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_uri_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite indole. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cro4. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2dmmq8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite q8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_26dap_M_exchg' since it already exists.

Ignoring reaction 'EX_2dmmq8_exchg' since it already exists.

Ignoring reaction 'EX_2obut_exchg' since it already exists.

Ignoring reaction 'EX_4abz_exchg' since it already exists.

Ignoring reaction 'EX_ac_exchg' since it already exists.

Ignoring reaction 'EX_acald_exchg' since it already exists.

Ignoring reaction 'EX_ade_exchg' since it already exists.

Ignoring reaction 'EX_adn_exchg' since it already exists.

Ignoring reaction 'EX_adocbl_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.

Ignoring reaction 'EX_arg_L_exchg' since it already exists.

Ignoring reaction 'EX_asp_L_exchg' since it already exists.

Ignoring reaction 'EX_ca2_exchg' since it already exists.

Ignoring reaction 'EX_cbl1_exchg' since it already exists.

Ignoring reaction 'EX_cbl2_exchg' since it already exists.

Ignoring reaction 'EX_cd2_exchg' since it already exists.

Ignoring reaction 'EX_cgly_exchg' since it already exists.

Ignoring reaction 'EX_chtbs_exchg' since it already exists.

Ignoring reaction 'EX_cl_exchg' since it already exists.

Ignoring reaction 'EX_co2_exchg' since it already exists.

Ignoring reaction 'EX_cobalt2_exchg' since it already exists.

Ignoring reaction 'EX_cro4_exchg' since it already exists.

Ignoring reaction 'EX_csn_exchg' since it already exists.

Ignoring reaction 'EX_cu2_exchg' since it already exists.

Ignoring reaction 'EX_cytd_exchg' since it already exists.

Ignoring reaction 'EX_dad_2_exchg' since it already exists.

Ignoring reaction 'EX_dcyt_exchg' since it already exists.

Ignoring reaction 'EX_dgsn_exchg' since it already exists.

Ignoring reaction 'EX_din_exchg' since it already exists.

Ignoring reaction 'EX_duri_exchg' since it already exists.

Ignoring reaction 'EX_fe2_exchg' since it already exists.

Ignoring reaction 'EX_fe3_exchg' since it already exists.

Ignoring reaction 'EX_for_exchg' since it already exists.

Ignoring reaction 'EX_fru_exchg' since it already exists.

Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_gsn_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h2s_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_ins_exchg' since it already exists.
Ignoring reaction 'EX_isobut_exchg' since it already exists.
Ignoring reaction 'EX_isocapr_exchg' since it already exists.
Ignoring reaction 'EX_isoal_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lcts_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mqn8_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_ocdcea_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_pnto_R_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.

Ignoring reaction 'EX_q8_exchg' since it already exists.
Ignoring reaction 'EX_raffin_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spmd_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_thymd_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_tsul_exchg' since it already exists.
Ignoring reaction 'EX_ttdca_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_uri_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xan_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite raffin. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite isocapr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite chtbs. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cro4. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite h2s. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 4abz. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2dmmq8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite q8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_15dap_exchg' since it already exists.

Ignoring reaction 'EX_2hyoxplac_exchg' since it already exists.

Ignoring reaction 'EX_34dhpha_exchg' since it already exists.

Ignoring reaction 'EX_3hphac_exchg' since it already exists.

Ignoring reaction 'EX_4hphac_exchg' since it already exists.

Ignoring reaction 'EX_5mta_exchg' since it already exists.

Ignoring reaction 'EX_HC00319_exchg' since it already exists.

Ignoring reaction 'EX_Lcyst_exchg' since it already exists.

Ignoring reaction 'EX_Lkynr_exchg' since it already exists.

Ignoring reaction 'EX_ac_exchg' since it already exists.

Ignoring reaction 'EX_acac_exchg' since it already exists.

Ignoring reaction 'EX_acald_exchg' since it already exists.

Ignoring reaction 'EX_acgam_exchg' since it already exists.

Ignoring reaction 'EX_adocbl_exchg' since it already exists.

Ignoring reaction 'EX_ala_D_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.

Ignoring reaction 'EX_alaasp_exchg' since it already exists.

Ignoring reaction 'EX_alagln_exchg' since it already exists.

Ignoring reaction 'EX_alaglu_exchg' since it already exists.

Ignoring reaction 'EX_alagly_exchg' since it already exists.
Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_alltn_exchg' since it already exists.
Ignoring reaction 'EX_arbt_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_aso3_exchg' since it already exists.
Ignoring reaction 'EX_aso4_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_bhb_exchg' since it already exists.
Ignoring reaction 'EX_btn_exchg' since it already exists.
Ignoring reaction 'EX_but_exchg' since it already exists.
Ignoring reaction 'EX_butso3_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cbl1_exchg' since it already exists.
Ignoring reaction 'EX_cbl2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_chol_exchg' since it already exists.
Ignoring reaction 'EX_cit_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cynt_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_dad_2_exchg' since it already exists.
Ignoring reaction 'EX_ddca_exchg' since it already exists.
Ignoring reaction 'EX_dgsn_exchg' since it already exists.
Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_etha_exchg' since it already exists.
Ignoring reaction 'EX_ethso3_exchg' since it already exists.
Ignoring reaction 'EX_etoh_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_fum_exchg' since it already exists.
Ignoring reaction 'EX_galct_D_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_galur_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_glc_n_exchg' since it already exists.

Ignoring reaction 'EX_glcr_exchg' since it already exists.
Ignoring reaction 'EX_glcur_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyb_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_h2_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h2s_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hdca_exchg' since it already exists.
Ignoring reaction 'EX_hexs_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_ind3ac_exchg' since it already exists.
Ignoring reaction 'EX_isetac_exchg' since it already exists.
Ignoring reaction 'EX_isobut_exchg' since it already exists.
Ignoring reaction 'EX_isoal_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_mal_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.

Ignoring reaction 'EX_mops_exchg' since it already exists.
Ignoring reaction 'EX_mqn7_exchg' since it already exists.
Ignoring reaction 'EX_mso3_exchg' since it already exists.
Ignoring reaction 'EX_n2_exchg' since it already exists.
Ignoring reaction 'EX_n2o_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_nmn_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
Ignoring reaction 'EX_no_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglN. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite ethso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite galct_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite isetac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite n2. Please make sure that the metabolite with this ID is indeed representing the same substance

in all models!

WARNING: no annotation overlap found for matching metabolite mso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mops. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sulfac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hexs. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 15dap. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite n2o. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite h2s. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite aso4. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pppn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance

in all models!

WARNING: no annotation overlap found for matching metabolite butso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 3hphac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite aso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite galur. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Ignoring reaction 'EX_o2_exchg' since it already exists.

Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_ppi_exchg' since it already exists.
Ignoring reaction 'EX_pppn_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_pyr_exchg' since it already exists.
Ignoring reaction 'EX_rib_D_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spmd_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_sulfac_exchg' since it already exists.
Ignoring reaction 'EX_taur_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_tsul_exchg' since it already exists.
Ignoring reaction 'EX_ttdca_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_urea_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xan_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_2hyoxplac_exchg' since it already exists.
Ignoring reaction 'EX_34dhpha_exchg' since it already exists.
Ignoring reaction 'EX_HC00319_exchg' since it already exists.
Ignoring reaction 'EX_Lcyst_exchg' since it already exists.
Ignoring reaction 'EX_Lkynr_exchg' since it already exists.
Ignoring reaction 'EX_ac_exchg' since it already exists.
Ignoring reaction 'EX_adocbl_exchg' since it already exists.
Ignoring reaction 'EX_akg_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.
Ignoring reaction 'EX_alaasp_exchg' since it already exists.
Ignoring reaction 'EX_alagln_exchg' since it already exists.
Ignoring reaction 'EX_alaglu_exchg' since it already exists.
Ignoring reaction 'EX_alagly_exchg' since it already exists.
Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_alltn_exchg' since it already exists.
Ignoring reaction 'EX_arab_L_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_aso3_exchg' since it already exists.
Ignoring reaction 'EX_aso4_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_bhb_exchg' since it already exists.
Ignoring reaction 'EX_btn_exchg' since it already exists.
Ignoring reaction 'EX_but_exchg' since it already exists.
Ignoring reaction 'EX_butso3_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cbl1_exchg' since it already exists.
Ignoring reaction 'EX_cbl2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cellb_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_ddca_exchg' since it already exists.
Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_etha_exchg' since it already exists.
Ignoring reaction 'EX_ethso3_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_fum_exchg' since it already exists.
Ignoring reaction 'EX_galct_D_exchg' since it already exists.
Ignoring reaction 'EX_galur_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glcr_exchg' since it already exists.
Ignoring reaction 'EX_glcur_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.

Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyb_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_h2_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h2s_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hdca_exchg' since it already exists.
Ignoring reaction 'EX_hexs_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_isetac_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_mal_L_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mops_exchg' since it already exists.
Ignoring reaction 'EX_mso3_exchg' since it already exists.
Ignoring reaction 'EX_n2_exchg' since it already exists.
Ignoring reaction 'EX_n2o_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
Ignoring reaction 'EX_no_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_ocdca_exchg' since it already exists.

Ignoring reaction 'EX_oxa_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
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Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_urea_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xyl_D_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagl_n. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite ethso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite galct_D. Please

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WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite n2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mops. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sulfac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hexs. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite n2o. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite h2s. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite aso4. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make

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WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

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WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite aso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cellb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite galur. Please make

sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglN. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite ethso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite isetac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mops. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sulfac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hexs. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite arab_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 4abz. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite butso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2dmmq8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite q8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Ignoring reaction 'EX_26dap_M_exchg' since it already exists.

Ignoring reaction 'EX_2dmmq8_exchg' since it already exists.

Ignoring reaction 'EX_2obut_exchg' since it already exists.

Ignoring reaction 'EX_4abz_exchg' since it already exists.

Ignoring reaction 'EX_4hbx_exchg' since it already exists.

Ignoring reaction 'EX_Lcyst_exchg' since it already exists.

Ignoring reaction 'EX_ac_exchg' since it already exists.

Ignoring reaction 'EX_acald_exchg' since it already exists.

Ignoring reaction 'EX_acgam_exchg' since it already exists.

Ignoring reaction 'EX_ala_D_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.

Ignoring reaction 'EX_alaasp_exchg' since it already exists.

Ignoring reaction 'EX_alagln_exchg' since it already exists.

Ignoring reaction 'EX_alaglu_exchg' since it already exists.

Ignoring reaction 'EX_alagly_exchg' since it already exists.

Ignoring reaction 'EX_alahis_exchg' since it already exists.

Ignoring reaction 'EX_alaleu_exchg' since it already exists.

Ignoring reaction 'EX_alathr_exchg' since it already exists.

Ignoring reaction 'EX_arab_D_exchg' since it already exists.

Ignoring reaction 'EX_arbt_exchg' since it already exists.

Ignoring reaction 'EX_arg_L_exchg' since it already exists.

Ignoring reaction 'EX_asn_L_exchg' since it already exists.

Ignoring reaction 'EX_asp_L_exchg' since it already exists.

Ignoring reaction 'EX_btn_exchg' since it already exists.
Ignoring reaction 'EX_butso3_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_cytd_exchg' since it already exists.
Ignoring reaction 'EX_dad_2_exchg' since it already exists.
Ignoring reaction 'EX_ethso3_exchg' since it already exists.
Ignoring reaction 'EX_etoh_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_fol_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_fum_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyb_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hexs_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.

Ignoring reaction 'EX_inost_exchg' since it already exists.
Ignoring reaction 'EX_isetac_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mops_exchg' since it already exists.
Ignoring reaction 'EX_mqn8_exchg' since it already exists.
Ignoring reaction 'EX_mso3_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_pnto_R_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_ppi_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_q8_exchg' since it already exists.
Ignoring reaction 'EX_ribflv_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spmd_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.

Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_sulfac_exchg' since it already exists.
Ignoring reaction 'EX_taur_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_thymd_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trp_L_exchg' since it already exists.
Ignoring reaction 'EX_ttdca_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_uri_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_12dgr180_exchg' since it already exists.
Ignoring reaction 'EX_26dap_M_exchg' since it already exists.
Ignoring reaction 'EX_3mop_exchg' since it already exists.
Ignoring reaction 'EX_4abz_exchg' since it already exists.
Ignoring reaction 'EX_4hbx_exchg' since it already exists.
Ignoring reaction 'EX_ac_exchg' since it already exists.
Ignoring reaction 'EX_acald_exchg' since it already exists.
Ignoring reaction 'EX_acgam_exchg' since it already exists.
Ignoring reaction 'EX_acnam_exchg' since it already exists.
Ignoring reaction 'EX_actn_R_exchg' since it already exists.
Ignoring reaction 'EX_adn_exchg' since it already exists.
Ignoring reaction 'EX_akg_exchg' since it already exists.
Ignoring reaction 'EX_ala_D_exchg' since it already exists.
Ignoring reaction 'EX_ala_L_exchg' since it already exists.
Ignoring reaction 'EX_alaasp_exchg' since it already exists.
Ignoring reaction 'EX_alagln_exchg' since it already exists.
Ignoring reaction 'EX_alaglu_exchg' since it already exists.
Ignoring reaction 'EX_alagly_exchg' since it already exists.
Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_arab_L_exchg' since it already exists.
Ignoring reaction 'EX_arbt_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_aso3_exchg' since it already exists.
Ignoring reaction 'EX_aso4_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_btn_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.

Ignoring reaction 'EX_chol_exchg' since it already exists.
Ignoring reaction 'EX_cit_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_crn_exchg' since it already exists.
Ignoring reaction 'EX_ctbt_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_cytd_exchg' since it already exists.
Ignoring reaction 'EX_dad_2_exchg' since it already exists.
Ignoring reaction 'EX_dcyt_exchg' since it already exists.
Ignoring reaction 'EX_dgsn_exchg' since it already exists.
Ignoring reaction 'EX_din_exchg' since it already exists.
Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_duri_exchg' since it already exists.
Ignoring reaction 'EX_etoh_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_fecrm_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_gal_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gbbtn_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_glc_n_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.
Ignoring reaction 'EX_glyb_exchg' since it already exists.
Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h2s_exchg' since it already exists.

Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_ins_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_lcts_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_mal_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_malthx_exchg' since it already exists.
Ignoring reaction 'EX_malttr_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_ni2_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_ppi_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_rib_D_exchg' since it already exists.
Ignoring reaction 'EX_ribflv_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_D_exchg' since it already exists.

Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spm�_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_thymd_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_urea_exchg' since it already exists.
Ignoring reaction 'EX_uri_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_xan_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 12dgr180. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglñ. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite ctbt. Please make

sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite ni2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite h2s. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite aso4. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite gbbtn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite actn_R. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 4abz. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make

sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn1. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite aso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite fecrm. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_12dgr180_exchg' since it already exists.

Ignoring reaction 'EX_26dap_M_exchg' since it already exists.

Ignoring reaction 'EX_2dmmq8_exchg' since it already exists.

Ignoring reaction 'EX_2obut_exchg' since it already exists.

Ignoring reaction 'EX_34dhphe_exchg' since it already exists.

Ignoring reaction 'EX_5htrp_exchg' since it already exists.

Ignoring reaction 'EX_ac_exchg' since it already exists.

Ignoring reaction 'EX_acald_exchg' since it already exists.

Ignoring reaction 'EX_acgam_exchg' since it already exists.

Ignoring reaction 'EX_acnam_exchg' since it already exists.

Ignoring reaction 'EX_ade_exchg' since it already exists.

Ignoring reaction 'EX_adocbl_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.

Ignoring reaction 'EX_alaasp_exchg' since it already exists.

Ignoring reaction 'EX_alagln_exchg' since it already exists.
Ignoring reaction 'EX_alaglu_exchg' since it already exists.
Ignoring reaction 'EX_alagly_exchg' since it already exists.
Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_amp_exchg' since it already exists.
Ignoring reaction 'EX_arab_L_exchg' since it already exists.
Ignoring reaction 'EX_arbt_exchg' since it already exists.
Ignoring reaction 'EX_arg_L_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_btn_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cbl1_exchg' since it already exists.
Ignoring reaction 'EX_cbl2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cellb_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_chtbs_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_csn_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_cytd_exchg' since it already exists.
Ignoring reaction 'EX_dad_2_exchg' since it already exists.
Ignoring reaction 'EX_dcyt_exchg' since it already exists.
Ignoring reaction 'EX_dgsn_exchg' since it already exists.
Ignoring reaction 'EX_dopa_exchg' since it already exists.
Ignoring reaction 'EX_etha_exchg' since it already exists.
Ignoring reaction 'EX_etoh_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
Ignoring reaction 'EX_fol_exchg' since it already exists.
Ignoring reaction 'EX_for_exchg' since it already exists.
Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_gal_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
Ignoring reaction 'EX_glc_D_exchg' since it already exists.
Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
Ignoring reaction 'EX_glyasn_exchg' since it already exists.
Ignoring reaction 'EX_glyasp_exchg' since it already exists.

Ignoring reaction 'EX_glyb_exchg' since it already exists.
Ignoring reaction 'EX_glyc_exchg' since it already exists.
Ignoring reaction 'EX_glyclt_exchg' since it already exists.
Ignoring reaction 'EX_glycys_exchg' since it already exists.
Ignoring reaction 'EX_glygln_exchg' since it already exists.
Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hista_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_ins_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_lcts_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
Ignoring reaction 'EX_malt_exchg' since it already exists.
Ignoring reaction 'EX_malthx_exchg' since it already exists.
Ignoring reaction 'EX_malttr_exchg' since it already exists.
Ignoring reaction 'EX_man_exchg' since it already exists.
Ignoring reaction 'EX_mantr_exchg' since it already exists.
Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mqn8_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_nmn_exchg' since it already exists.
Ignoring reaction 'EX_o2_exchg' since it already exists.
Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pHEME_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_pnto_R_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.

Ignoring reaction 'EX_pro_L_exchg' since it already exists.
Ignoring reaction 'EX_ptrc_exchg' since it already exists.
Ignoring reaction 'EX_pydam_exchg' since it already exists.
Ignoring reaction 'EX_pydx_exchg' since it already exists.
Ignoring reaction 'EX_pydxn_exchg' since it already exists.
Ignoring reaction 'EX_q8_exchg' since it already exists.
Ignoring reaction 'EX_ribflv_exchg' since it already exists.
Ignoring reaction 'EX_salcn_exchg' since it already exists.
Ignoring reaction 'EX_sbt_D_exchg' since it already exists.
Ignoring reaction 'EX_ser_L_exchg' since it already exists.
Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spmd_exchg' since it already exists.
Ignoring reaction 'EX_srtm_exchg' since it already exists.
Ignoring reaction 'EX_stys_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_thymd_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_trypta_exchg' since it already exists.
Ignoring reaction 'EX_tym_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_urea_exchg' since it already exists.
Ignoring reaction 'EX_uri_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 12dgr180. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glycys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite chtbs. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite stys. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mantr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 2dmmq8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite q8. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cellb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

Note: no products in the objective function, adding biomass to it.

Ignoring reaction 'EX_26dap_M_exchg' since it already exists.

Ignoring reaction 'EX_3mop_exchg' since it already exists.

Ignoring reaction 'EX_4abz_exchg' since it already exists.

Ignoring reaction 'EX_4hbz_exchg' since it already exists.

Ignoring reaction 'EX_Lcyst_exchg' since it already exists.

Ignoring reaction 'EX_ac_exchg' since it already exists.

Ignoring reaction 'EX_acald_exchg' since it already exists.

Ignoring reaction 'EX_acgam_exchg' since it already exists.

Ignoring reaction 'EX_adocbl_exchg' since it already exists.

Ignoring reaction 'EX_akg_exchg' since it already exists.

Ignoring reaction 'EX_ala_D_exchg' since it already exists.

Ignoring reaction 'EX_ala_L_exchg' since it already exists.

Ignoring reaction 'EX_alaasp_exchg' since it already exists.

Ignoring reaction 'EX_alagln_exchg' since it already exists.

Ignoring reaction 'EX_alaglu_exchg' since it already exists.

Ignoring reaction 'EX_alagly_exchg' since it already exists.

Ignoring reaction 'EX_alahis_exchg' since it already exists.
Ignoring reaction 'EX_alaleu_exchg' since it already exists.
Ignoring reaction 'EX_alathr_exchg' since it already exists.
Ignoring reaction 'EX_amp_exchg' since it already exists.
Ignoring reaction 'EX_arbt_exchg' since it already exists.
Ignoring reaction 'EX_asn_L_exchg' since it already exists.
Ignoring reaction 'EX_asp_L_exchg' since it already exists.
Ignoring reaction 'EX_btn_exchg' since it already exists.
Ignoring reaction 'EX_butso3_exchg' since it already exists.
Ignoring reaction 'EX_ca2_exchg' since it already exists.
Ignoring reaction 'EX_cbl1_exchg' since it already exists.
Ignoring reaction 'EX_cbl2_exchg' since it already exists.
Ignoring reaction 'EX_cd2_exchg' since it already exists.
Ignoring reaction 'EX_cgly_exchg' since it already exists.
Ignoring reaction 'EX_cl_exchg' since it already exists.
Ignoring reaction 'EX_co2_exchg' since it already exists.
Ignoring reaction 'EX_cobalt2_exchg' since it already exists.
Ignoring reaction 'EX_cu2_exchg' since it already exists.
Ignoring reaction 'EX_cys_L_exchg' since it already exists.
Ignoring reaction 'EX_dcyt_exchg' since it already exists.
Ignoring reaction 'EX_drib_exchg' since it already exists.
Ignoring reaction 'EX_ethso3_exchg' since it already exists.
Ignoring reaction 'EX_fe2_exchg' since it already exists.
Ignoring reaction 'EX_fe3_exchg' since it already exists.
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Ignoring reaction 'EX_fru_exchg' since it already exists.
Ignoring reaction 'EX_fum_exchg' since it already exists.
Ignoring reaction 'EX_galt_exchg' since it already exists.
Ignoring reaction 'EX_gam_exchg' since it already exists.
Ignoring reaction 'EX_gcald_exchg' since it already exists.
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Ignoring reaction 'EX_gln_L_exchg' since it already exists.
Ignoring reaction 'EX_glu_L_exchg' since it already exists.
Ignoring reaction 'EX_gly_exchg' since it already exists.
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Ignoring reaction 'EX_glyc3p_exchg' since it already exists.
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Ignoring reaction 'EX_glyglu_exchg' since it already exists.
Ignoring reaction 'EX_glyleu_exchg' since it already exists.
Ignoring reaction 'EX_glymet_exchg' since it already exists.
Ignoring reaction 'EX_glyphe_exchg' since it already exists.
Ignoring reaction 'EX_glypro_exchg' since it already exists.
Ignoring reaction 'EX_glytyr_exchg' since it already exists.
Ignoring reaction 'EX_gua_exchg' since it already exists.

Ignoring reaction 'EX_h2_exchg' since it already exists.
Ignoring reaction 'EX_h2o_exchg' since it already exists.
Ignoring reaction 'EX_h_exchg' since it already exists.
Ignoring reaction 'EX_hexs_exchg' since it already exists.
Ignoring reaction 'EX_hg2_exchg' since it already exists.
Ignoring reaction 'EX_his_L_exchg' since it already exists.
Ignoring reaction 'EX_hxan_exchg' since it already exists.
Ignoring reaction 'EX_ile_L_exchg' since it already exists.
Ignoring reaction 'EX_ind3ac_exchg' since it already exists.
Ignoring reaction 'EX_isetac_exchg' since it already exists.
Ignoring reaction 'EX_k_exchg' since it already exists.
Ignoring reaction 'EX_lac_D_exchg' since it already exists.
Ignoring reaction 'EX_lac_L_exchg' since it already exists.
Ignoring reaction 'EX_leu_L_exchg' since it already exists.
Ignoring reaction 'EX_lys_L_exchg' since it already exists.
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Ignoring reaction 'EX_met_D_exchg' since it already exists.
Ignoring reaction 'EX_met_L_exchg' since it already exists.
Ignoring reaction 'EX_metala_exchg' since it already exists.
Ignoring reaction 'EX_metsox_R_L_exchg' since it already exists.
Ignoring reaction 'EX_metsox_S_L_exchg' since it already exists.
Ignoring reaction 'EX_mg2_exchg' since it already exists.
Ignoring reaction 'EX_mn2_exchg' since it already exists.
Ignoring reaction 'EX_mnl_exchg' since it already exists.
Ignoring reaction 'EX_mops_exchg' since it already exists.
Ignoring reaction 'EX_mso3_exchg' since it already exists.
Ignoring reaction 'EX_na1_exchg' since it already exists.
Ignoring reaction 'EX_nac_exchg' since it already exists.
Ignoring reaction 'EX_nh4_exchg' since it already exists.
Ignoring reaction 'EX_no2_exchg' since it already exists.
Ignoring reaction 'EX_no3_exchg' since it already exists.
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Ignoring reaction 'EX_ocdca_exchg' since it already exists.
Ignoring reaction 'EX_orn_exchg' since it already exists.
Ignoring reaction 'EX_pb_exchg' since it already exists.
Ignoring reaction 'EX_phe_L_exchg' since it already exists.
Ignoring reaction 'EX_pheme_exchg' since it already exists.
Ignoring reaction 'EX_pi_exchg' since it already exists.
Ignoring reaction 'EX_pime_exchg' since it already exists.
Ignoring reaction 'EX_ppa_exchg' since it already exists.
Ignoring reaction 'EX_ppi_exchg' since it already exists.
Ignoring reaction 'EX_pro_L_exchg' since it already exists.
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Ignoring reaction 'EX_pydxn_exchg' since it already exists.

Ignoring reaction 'EX_pyr_exchg' since it already exists.
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Ignoring reaction 'EX_salcn_exchg' since it already exists.
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Ignoring reaction 'EX_sheme_exchg' since it already exists.
Ignoring reaction 'EX_so4_exchg' since it already exists.
Ignoring reaction 'EX_spmd_exchg' since it already exists.
Ignoring reaction 'EX_succ_exchg' since it already exists.
Ignoring reaction 'EX_sucr_exchg' since it already exists.
Ignoring reaction 'EX_sulfac_exchg' since it already exists.
Ignoring reaction 'EX_taur_exchg' since it already exists.
Ignoring reaction 'EX_thm_exchg' since it already exists.
Ignoring reaction 'EX_thr_L_exchg' since it already exists.
Ignoring reaction 'EX_tre_exchg' since it already exists.
Ignoring reaction 'EX_tyr_L_exchg' since it already exists.
Ignoring reaction 'EX_ura_exchg' since it already exists.
Ignoring reaction 'EX_val_L_exchg' since it already exists.
Ignoring reaction 'EX_zn2_exchg' since it already exists.

WARNING: no annotation overlap found for matching metabolite glytyr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

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WARNING: no annotation overlap found for matching metabolite alagln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite ethso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaleu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cd2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_S_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite isetac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alathr. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cobalt2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mops. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sulfac. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite hexs. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 26dap_M. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite zn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mg2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite 4abz. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite no3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite butso3. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite metsox_R_L. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glymet. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite met_D. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite sheme. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pime. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasp. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite mnl. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite cu2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alagly. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite alaglu. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite pb. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glyasn. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

WARNING: no annotation overlap found for matching metabolite glygln. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!

No constrained community model set yet. Using the unconstrained model instead.

WARNING: Not all reactions in the model are mass and charge balanced. To check which reactions are imbalanced, please run the `get_unbalanced_reactions` method of this `CommunityModel` object

Generated unconstrained community model.

[9]: <Model henson_community_model at 0x158cf8e2c10>

The output of the community model creation contains quite some lines of info and warnings. This is to be expected. Let's have a look at the different types of info: 1. *Ignoring reaction 'EX_4abz_exchg' since it already exists.* This line will come up if a reaction is present in two different community member models under the same ID. This will only happen for exchange reactions

in the exchange compartment and are therefor correct behaviour. 2. *WARNING: no annotation overlap found for matching metabolite mn2. Please make sure that the metabolite with this ID is indeed representing the same substance in all models!* This warning comes up if exchange metabolites do not contain any matching annotation field. This can be an indicator that metabolites with the same ID are merged, but they represent different chemicals. Another common cause is that no annotation was given for this metabolite in one of the models. 3. *WARNING: matching of the metabolite CO2_EX is unbalanced (mass and/or charge). Please manually curate this metabolite for a mass and charge balanced model!* This warning means that the formula of an exchange metabolite was different between member models. This can be due to the formula being omitted in some of the models. The other reason is that the metabolites differ in their mass or charge. As this would lead to generation or loss of matter from nothing, these issues need to be resolved for a consistent metabolic model.

1.1.3 Setting the community member composition

For the bounds of the model and the normalisation to be correct, the fractions of all community members must be set (and sum up to 1.0). A quick way to do this is to set the abundance fractions equal for all community members.

```
[10]: com_model_obj.equal_abundance()
```

```
[10]: <Model henson_community_model at 0x158e87de820>
```

Now let us check if the biomass function was updated accordingly as well

```
[11]: com_model_obj.community_model.reactions.get_by_id("community_biomass").reaction
```

```
[11]: '0.058823529411764705 Achromobacter_xylosoxidans_NBRC_15126_cpd11416_Achromobacter_xylosoxidans_NBRC_15126_exchg + 0.058823529411764705 Actinomyces_naeslundii_str_Howell_279_cpd11416_Actinomyces_naeslundii_str_Howell_279_exchg + 0.058823529411764705 Burkholderia_cepacia_GG4_cpd11416_Burkholderia_cepacia_GG4_exchg + 0.058823529411764705 Escherichia_coli_str_K_12_substr_MG1655_cpd11416_Escherichia_coli_str_K_12_substr_MG1655_exchg + 0.058823529411764705 Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_cpd11416_Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_exchg + 0.058823529411764705 Gemella_haemolysans_ATCC_10379_cpd11416_Gemella_haemolysans_ATCC_10379_exchg + 0.058823529411764705 Granulicatella_adiacens_ATCC_49175_cpd11416_Granulicatella_adiacens_ATCC_49175_exchg + 0.058823529411764705 Haemophilus_influenzae_R2846_cpd11416_Haemophilus_influenzae_R2846_exchg + 0.058823529411764705 Neisseria_flavescens_SK114_cpd11416_Neisseria_flavescens_SK114_exchg + 0.058823529411764705 Porphyromonas_endodontalis_ATCC_35406_cpd11416_Porphyromonas_endodontalis_ATCC_35406_exchg + 0.058823529411764705 Prevotella_melaninogenica_ATCC_25845_cpd11416_Prevotella_melaninogenica_ATCC_25845_exchg + 0.058823529411764705 Pseudomonas_aeruginosa_NCGM2_S1_cpd11416_Pseudomonas_aeruginosa_NCGM2_S1_exchg + 0.058823529411764705'
```

```
Ralstonia_sp_5_7_47FAA_cpd11416_Ralstonia_sp_5_7_47FAA_exchg +
0.058823529411764705
Rothia_mucilaginosa_DY_18_cpd11416_Rothia_mucilaginosa_DY_18_exchg +
0.058823529411764705 Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_cpd11416_
Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_exchg + 0.058823529411764705
Streptococcus_sanguinis_SK36_cpd11416_Streptococcus_sanguinis_SK36_exchg +
0.058823529411764705 Veillonella_atypica_ACS_049_V_Sch6_cpd11416_Veillonella_aty
pica_ACS_049_V_Sch6_exchg --> cpd11416_exchg'
```

As can be seen above, the biomass function now takes an equal amount of all 17 community members, 1/17th or 0.0588...

1.1.4 Quality Checks

One of the quality checks that should be done is to look into all unbalanced reactions (mass and charge) in the entire model. As said before, such reactions should only exist in the case of boundary reactions, such as exchange, sink and source reactions.

```
[12]: com_model_obj.get_unbalanced_reactions()
```

```
[12]: {<Reaction Achromobacter_xylosoxidans_NBRC_15126_DM_5DRIB_Achromobacter_xylosoxi
dans_NBRC_15126_c at 0x158eb67bdf0>: {'C': -5.0,
    'H': -10.0,
    'O': -4.0},
    <Reaction Achromobacter_xylosoxidans_NBRC_15126_DM_5MTR_Achromobacter_xylosoxi
ans_NBRC_15126_c at 0x158eb67bf10>: {'C': -6.0,
    'H': -12.0,
    'O': -4.0,
    'S': -1.0},
    <Reaction Achromobacter_xylosoxidans_NBRC_15126_DM_dhptd_Achromobacter_xylosoxi
dans_NBRC_15126_c at 0x158eb67bee0>: {'C': -5.0,
    'H': -8.0,
    'O': -4.0},
    <Reaction Achromobacter_xylosoxidans_NBRC_15126_DM_hcys_L_Achromobacter_xylosox
idans_NBRC_15126_c at 0x158eb67bfd0>: {'C': -4.0,
    'H': -9.0,
    'N': -1.0,
    'O': -2.0,
    'S': -1.0},
    <Reaction Achromobacter_xylosoxidans_NBRC_15126_EX_biomass_e_Achromobacter_xylo
soxidans_NBRC_15126_c at 0x158eb6b5d30>: {'X': -1.0},
    <Reaction Achromobacter_xylosoxidans_NBRC_15126_drepliation_Achromobacter_xylo
soxidans_NBRC_15126_c at 0x158eb92fd60>: {'X': 1.0},
    <Reaction Achromobacter_xylosoxidans_NBRC_15126_pbiosynthesis_Achromobacter_xyl
osoxidans_NBRC_15126_c at 0x158eb92f340>: {'X': 1.0},
    <Reaction Achromobacter_xylosoxidans_NBRC_15126_rtranscription_Achromobacter_xy
losoxidans_NBRC_15126_c at 0x158eb943460>: {'X': 1.0},
    <Reaction Achromobacter_xylosoxidans_NBRC_15126_biomass489 at 0x158eb943dc0>:
```

```

{'charge': 0.85562500000000518,
 'C': -39.340403000000007,
 'H': -62.77818650000005,
 'N': -8.5764294999999936,
 'O': -14.3107830000000422,
 'P': -0.81205750000000315,
 'S': -0.222525,
 'X': -2.0,
 'Co': -0.0030965,
 'Ca': -0.0030965,
 'Cl': -0.0030965,
 'Cu': -0.0030965,
 'Fe': -0.012386,
 'K': -0.0030965,
 'Mg': -0.0030965,
 'Mn': -0.0030965,
 'Zn': -0.0030965},
<Reaction Actinomyces_naeslundii_str_Howell_279_DM_5MTR_Actinomyces_naeslundii_
str_Howell_279_c at 0x158eba404f0>: {'C': -6.0,
 'H': -12.0,
 'O': -4.0,
 'S': -1.0},
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tr_Howell_279_c at 0x158eba405b0>: {'C': -6.0,
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 'O': -2.0},
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 'N': -1.0,
 'O': -2.0,
 'S': -1.0},
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ndii_str_Howell_279_c at 0x158eba63490>: {'X': -1.0},
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tr_Howell_279_c at 0x158ebbe5f70>: {'C': -286.0,
 'H': -477.0,
 'N': -47.0,
 'O': -238.0,
 'P': -46.0},
<Reaction Actinomyces_naeslundii_str_Howell_279_TECAGE_Actinomyces_naeslundii_s
tr_Howell_279_c at 0x158ebbe53a0>: {'charge': 45.0,
 'C': -421.0,

```

```

'H': -747.0,
'N': -2.0,
'O': -463.0,
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tr_Howell_279_c at 0x158ebbec6a0>: {'charge': 45.0,
'C': -151.0,
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'N': -2.0,
'O': -238.0,
'P': -46.0},
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str_Howell_279_c at 0x158ebbec850>: {'charge': 45.0,
'C': -630.0,
'H': -945.0,
'N': -45.0,
'O': -630.0,
'P': -45.0,
'X': 1.0},
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ndii_str_Howell_279_c at 0x158ebc13f70>: {'X': 1.0},
<Reaction Actinomyces_naeslundii_str_Howell_279_pbiosynthesis_Actinomyces_naesl
undii_str_Howell_279_c at 0x158ebc13730>: {'X': 1.0},
<Reaction Actinomyces_naeslundii_str_Howell_279_rtranscription_Actinomyces_naes
lundii_str_Howell_279_c at 0x158ebc2d7c0>: {'X': 1.0},
<Reaction Actinomyces_naeslundii_str_Howell_279_biomass492 at 0x158ebc2d880>:
{'charge': 0.85562500000000518,
'C': -39.340300000000005,
'H': -62.778083500000042,
'N': -8.576532499999996,
'O': -14.3107830000000422,
'P': -0.81205750000000315,
'S': -0.222525,
'X': -2.0,
'Co': -0.0030965,
'Ca': -0.0030965,
'Cl': -0.0030965,
'Cu': -0.0030965,
'Fe': -0.012386,
'K': -0.0030965,
'Mg': -0.0030965,
'Mn': -0.0030965,
'Zn': -0.0030965},
<Reaction Burkholderia_cepacia_GG4_DM_2HYMEPH_Burkholderia_cepacia_GG4_c at
0x158ebda8760>: {'C': -7.0,
'H': -8.0,
'O': -2.0},

```



```

<Reaction Burkholderia_cepacia_GG4_DM_4HBA_Burkholderia_cepacia_GG4_c at
0x158ebda8910>: {'C': -7.0,
  'H': -8.0,
  'O': -2.0},
<Reaction Burkholderia_cepacia_GG4_DM_5DRIB_Burkholderia_cepacia_GG4_c at
0x158ebda89d0>: {'C': -5.0,
  'H': -10.0,
  'O': -4.0},
<Reaction Burkholderia_cepacia_GG4_DM_5MTR_Burkholderia_cepacia_GG4_c at
0x158ebda81f0>: {'C': -6.0,
  'H': -12.0,
  'O': -4.0,
  'S': -1.0},
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  'H': -4.0,
  'O': -2.0},
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  'H': -13.0,
  'N': -5.0,
  'O': -3.0},
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  'H': -8.0,
  'O': -4.0},
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  'H': -9.0,
  'N': -1.0,
  'O': -2.0,
  'S': -1.0},
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0x158ebddeee0>: {'X': -1.0},
<Reaction Burkholderia_cepacia_GG4_SHCHCC2_Burkholderia_cepacia_GG4_c at
0x158ec029e80>: {'charge': -2.0},
<Reaction Burkholderia_cepacia_GG4_drepliation_Burkholderia_cepacia_GG4_c at
0x158ec08c730>: {'X': 1.0},
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0x158ec08cb80>: {'X': 1.0},
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  'H': -62.778482500000436,
  'N': -8.5761654999999949,

```

'O': -14.3108090000000356,
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 'Ca': -0.0030965,
 'Cl': -0.0030965,
 'Cu': -0.0030965,
 'Fe': -0.012386,
 'K': -0.0030965,
 'Mg': -0.0030965,
 'Mn': -0.0030965,
 'Zn': -0.0030965},
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 'H': -8.0,
 'O': -2.0},
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 'H': -19.0,
 'N': -5.0,
 'O': -6.0,
 'S': -1.0},
 <Reaction Escherichia_coli_str_K_12_substr_MG1655_DM_HQN_Escherichia_coli_str_K_12_substr_MG1655_c at 0x158ec24c3a0>: {'C': -6.0,
 'H': -6.0,
 'O': -2.0},
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 'N': -2.0,
 'O': -3.0,
 'S': -1.0},
 <Reaction Escherichia_coli_str_K_12_substr_MG1655_DM_Escherichia_coli_str_K_12_substr_MG1655_clpn140_Escherichia_coli_str_K_12_substr_MG1655_c at 0x158ec24cc70>: {'charge': 2.0,
 'C': -65.0,
 'H': -124.0,
 'O': -17.0,
 'P': -2.0},

```

<Reaction Escherichia_coli_str_K_12_substr_MG1655_DM_Escherichia_coli_str_K_12_
substr_MG1655_clpn160_Escherichia_coli_str_K_12_substr_MG1655_c at
0x158ec24cd00>: {'charge': 2.0,
  'C': -73.0,
  'H': -140.0,
  'O': -17.0,
  'P': -2.0},
<Reaction Escherichia_coli_str_K_12_substr_MG1655_DM_Escherichia_coli_str_K_12_
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0x158ec24cd90>: {'charge': 2.0,
  'C': -81.0,
  'H': -156.0,
  'O': -17.0,
  'P': -2.0},
<Reaction Escherichia_coli_str_K_12_substr_MG1655_DM_Escherichia_coli_str_K_12_
substr_MG1655_clpn116_Escherichia_coli_str_K_12_substr_MG1655_c at
0x158ec24ce20>: {'charge': 2.0,
  'C': -73.0,
  'H': -140.0,
  'O': -17.0,
  'P': -2.0},
<Reaction Escherichia_coli_str_K_12_substr_MG1655_DM_dad_5_Escherichia_coli_str
_K_12_substr_MG1655_c at 0x158ec24ceb0>: {'C': -10.0,
  'H': -13.0,
  'N': -5.0,
  'O': -3.0},
<Reaction Escherichia_coli_str_K_12_substr_MG1655_DM_dhptd_Escherichia_coli_str
_K_12_substr_MG1655_c at 0x158ec24cf40>: {'C': -5.0,
  'H': -8.0,
  'O': -4.0},
<Reaction Escherichia_coli_str_K_12_substr_MG1655_DM_kdo2lipid4L_Escherichia_co
li_str_K_12_substr_MG1655_c at 0x158ec24cfd0>: {'charge': 6.0,
  'C': -96.0,
  'H': -170.0,
  'N': -2.0,
  'O': -38.0,
  'P': -2.0},
<Reaction Escherichia_coli_str_K_12_substr_MG1655_EX_biomass_e_Escherichia_coli
_str_K_12_substr_MG1655_c at 0x158ec2ed670>: {'X': -1.0},
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12_substr_MG1655_c at 0x158ec38cfa0>: {'charge': -1.0,
  'H': -1.0,
  'X': 1.0},
<Reaction Escherichia_coli_str_K_12_substr_MG1655_GLCS3_Escherichia_coli_str_K_
12_substr_MG1655_c at 0x158ec3919a0>: {'charge': -1.0,
  'H': -1.0,
  'X': -1.0},

```

```

<Reaction Escherichia_coli_str_K_12_substr_MG1655_drepllication_Escherichia_coli_str_K_12_substr_MG1655_c at 0x158ec580550>: {'X': 1.0},
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<Reaction Escherichia_coli_str_K_12_substr_MG1655_rtranscription_Escherichia_coli_str_K_12_substr_MG1655_c at 0x158ec5a0850>: {'X': 1.0},
<Reaction Escherichia_coli_str_K_12_substr_MG1655_sink_s_Escherichia_coli_str_K_12_substr_MG1655_c at 0x158ec5a0a90>: {'S': -1.0},
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  'C': -41.423097400000013,
  'H': -63.273870999999998,
  'N': -10.9520102000000075,
  'O': -15.854016600000002,
  'P': -1.17067879999999961,
  'S': -0.2695576,
  'X': -2.0,
  'Ca': -0.0078094,
  'Cl': -0.0078094,
  'Co': -0.0078094,
  'Cu': -0.0078094,
  'Fe': -0.0156188,
  'K': -0.0078094,
  'Mg': -0.0078094,
  'Mn': -0.0078094,
  'Zn': -0.0078094},
<Reaction Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_DM_5MTR_Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_c at 0x158ec6c8fd0>: {'C': -6.0,
  'H': -12.0,
  'O': -4.0,
  'S': -1.0},
<Reaction Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_DM_dhptd_Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_c at 0x158ec6c82e0>: {'C': -5.0,
  'H': -8.0,
  'O': -4.0},
<Reaction Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_DM_hcys_L_Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_c at 0x158ec6c8fa0>: {'C': -4.0,
  'H': -9.0,
  'N': -1.0,
  'O': -2.0,
  'S': -1.0},
<Reaction Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_EX_biomass_e_Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_c at 0x158ec6ea640>: {'X': -1.0},
<Reaction Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_NADH8 at 0x158ec7abf70>: {'H': 3.552713678800501e-15},
<Reaction Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_SHCHCC2_Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_c at 0x158ec819940>: {'charge': -2.0},

```

```

<Reaction Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_dreplication_Fusobacterium_nucleatum_subsp_nucleatum_ATCC_25586_c at 0x158ec849970>: {'X': 1.0},
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Gemella_haemolysans_ATCC_10379_DM_hcys_L_Gemella_haemolysans_ATCC_10379_c at 0x158ec8e4220>: {'C': -4.0,
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0x158eca46fa0>: {'X': 1.0},
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at 0x158eca5bc70>: {'X': 1.0},
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Gemella_haemolysans_ATCC_10379_sink_PGPm1_Gemella_haemolysans_ATCC_10379_c at
0x158eca5bd30>: {'X': -1.0},
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{'charge': -81.868803199999989,
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 'N': -7.3508707999999993,
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at 0x158ecaffa00>: {'C': -5.0,
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at 0x158ecc2fca0>: {'charge': -30.0,
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at 0x158ecd20760>: {'C': -6.0,
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at 0x158ecd20b80>: {'C': -5.0,
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at 0x158ecd20370>: {'C': -4.0,
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0x158ecef35b0>: {'X': 1.0},
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at 0x158ed16ffd0>: {'X': 1.0},
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0x158ed6cb220>: {'C': -10.0,
  'H': -13.0,
  'N': -5.0,
  'O': -3.0},
<Reaction
Pseudomonas_aeruginosa_NCGM2_S1_DM_kdo2lipid4L_Pseudomonas_aeruginosa_NCGM2_S1_c
at 0x158ed6cb2b0>: {'charge': 6.0,
  'C': -96.0,
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  'N': -2.0,
  'O': -38.0,
  'P': -2.0},
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Pseudomonas_aeruginosa_NCGM2_S1_EX_biomass_e_Pseudomonas_aeruginosa_NCGM2_S1_c
at 0x158ed6fc700>: {'X': -1.0},
<Reaction
Pseudomonas_aeruginosa_NCGM2_S1_GLCP3_Pseudomonas_aeruginosa_NCGM2_S1_c at
0x158ed77cf70>: {'charge': -1.0,
  'H': -1.0,
  'X': 1.0},
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Pseudomonas_aeruginosa_NCGM2_S1_GLCS3_Pseudomonas_aeruginosa_NCGM2_S1_c at
0x158ed782220>: {'charge': -1.0,
  'H': -1.0,
  'X': -1.0},
<Reaction
Pseudomonas_aeruginosa_NCGM2_S1_TECAAE_Pseudomonas_aeruginosa_NCGM2_S1_c at
0x158ed90f5e0>: {'C': -286.0,
  'H': -477.0,
  'N': -47.0,
  'O': -238.0,
  'P': -46.0},
<Reaction
Pseudomonas_aeruginosa_NCGM2_S1_TECAGE_Pseudomonas_aeruginosa_NCGM2_S1_c at
0x158ed90f340>: {'charge': 45.0,
  'C': -421.0,
  'H': -747.0,
  'N': -2.0,
  'O': -463.0,
  'P': -46.0},
<Reaction
Pseudomonas_aeruginosa_NCGM2_S1_TECAUE_Pseudomonas_aeruginosa_NCGM2_S1_c at
0x158ed90ffd0>: {'charge': 45.0,
  'C': -151.0,
  'H': -297.0,
  'N': -2.0,
  'O': -238.0,

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    'P': -46.0},
    <Reaction
Pseudomonas_aeruginosa_NCGM2_S1_drepllication_Pseudomonas_aeruginosa_NCGM2_S1_c
at 0x158ed93e1c0>: {'X': 1.0},
    <Reaction
Pseudomonas_aeruginosa_NCGM2_S1_pbiosynthesis_Pseudomonas_aeruginosa_NCGM2_S1_c
at 0x158ed93e100>: {'X': 1.0},
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Pseudomonas_aeruginosa_NCGM2_S1_rtranscription_Pseudomonas_aeruginosa_NCGM2_S1_c
at 0x158ed958ee0>: {'X': 1.0},
    <Reaction
Pseudomonas_aeruginosa_NCGM2_S1_sink_s_Pseudomonas_aeruginosa_NCGM2_S1_c at
0x158ed95c5e0>: {'S': -1.0},
    <Reaction Pseudomonas_aeruginosa_NCGM2_S1_biomass345 at 0x158ed95c220>:
{'charge': 0.8556510000000081,
 'C': -39.346156000000004,
 'H': -62.783964500000044,
 'N': -8.5708654999999943,
 'O': -14.3108950000000304,
 'P': -0.81207950000000108,
 'S': -0.222525,
 'X': -2.0,
 'Co': -0.0030965,
 'Ca': -0.0030965,
 'Cl': -0.0030965,
 'Cu': -0.0030965,
 'Fe': -0.012386,
 'K': -0.0030965,
 'Mg': -0.0030965,
 'Mn': -0.0030965,
 'Zn': -0.0030965},
    <Reaction Ralstonia_sp_5_7_47FAA_DM_4HBA_Ralstonia_sp_5_7_47FAA_c at
0x158e7f50550>: {'C': -7.0,
 'H': -8.0,
 'O': -2.0},
    <Reaction Ralstonia_sp_5_7_47FAA_DM_5DRIB_Ralstonia_sp_5_7_47FAA_c at
0x158e7f3bd60>: {'C': -5.0,
 'H': -10.0,
 'O': -4.0},
    <Reaction Ralstonia_sp_5_7_47FAA_DM_AMOB_Ralstonia_sp_5_7_47FAA_c at
0x158e7f3b820>: {'C': -15.0,
 'H': -19.0,
 'N': -5.0,
 'O': -6.0,
 'S': -1.0},
    <Reaction Ralstonia_sp_5_7_47FAA_DM_btn_Ralstonia_sp_5_7_47FAA_c at
0x158e7f27a30>: {'charge': 1.0,

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'C': -10.0,
'H': -15.0,
'N': -2.0,
'O': -3.0,
'S': -1.0},
<Reaction Ralstonia_sp_5_7_47FAA_DM_Ralstonia_sp_5_7_47FAA_clpn140_Ralstonia_sp_5_7_47FAA_c at 0x158e7f27730>: {'charge': 2.0,
'C': -65.0,
'H': -124.0,
'O': -17.0,
'P': -2.0},
<Reaction Ralstonia_sp_5_7_47FAA_DM_Ralstonia_sp_5_7_47FAA_clpn160_Ralstonia_sp_5_7_47FAA_c at 0x158e7f14df0>: {'charge': 2.0,
'C': -73.0,
'H': -140.0,
'O': -17.0,
'P': -2.0},
<Reaction Ralstonia_sp_5_7_47FAA_DM_Ralstonia_sp_5_7_47FAA_clpn180_Ralstonia_sp_5_7_47FAA_c at 0x158e7f27430>: {'charge': 2.0,
'C': -81.0,
'H': -156.0,
'O': -17.0,
'P': -2.0},
<Reaction Ralstonia_sp_5_7_47FAA_DM_Ralstonia_sp_5_7_47FAA_clpni16_Ralstonia_sp_5_7_47FAA_c at 0x158e7f27130>: {'charge': 2.0,
'C': -73.0,
'H': -140.0,
'O': -17.0,
'P': -2.0},
<Reaction Ralstonia_sp_5_7_47FAA_DM_dad_5_Ralstonia_sp_5_7_47FAA_c at 0x158e7f27eb0>: {'C': -10.0,
'H': -13.0,
'N': -5.0,
'O': -3.0},
<Reaction Ralstonia_sp_5_7_47FAA_DM_kdo2lipid4L_Ralstonia_sp_5_7_47FAA_c at 0x158e8595fa0>: {'charge': 6.0,
'C': -96.0,
'H': -170.0,
'N': -2.0,
'O': -38.0,
'P': -2.0},
<Reaction Ralstonia_sp_5_7_47FAA_EX_biomass_e_Ralstonia_sp_5_7_47FAA_c at 0x158e510c610>: {'X': -1.0},
<Reaction Ralstonia_sp_5_7_47FAA_GLCS3_Ralstonia_sp_5_7_47FAA_c at 0x158e62ba910>: {'charge': -1.0,
'H': -1.0,
'X': -1.0},

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<Reaction Ralstonia_sp_5_7_47FAA_SHCHCC2_Ralstonia_sp_5_7_47FAA_c at
0x158edaf3a30>: {'charge': -2.0},
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0x158edb3e610>: {'X': 1.0},
<Reaction Ralstonia_sp_5_7_47FAA_pbiosynthesis_Ralstonia_sp_5_7_47FAA_c at
0x158edb3e940>: {'X': 1.0},
<Reaction Ralstonia_sp_5_7_47FAA_rtranscription_Ralstonia_sp_5_7_47FAA_c at
0x158edb53a60>: {'X': 1.0},
<Reaction Ralstonia_sp_5_7_47FAA_sink_s_Ralstonia_sp_5_7_47FAA_c at
0x158edb53b20>: {'S': -1.0},
<Reaction Ralstonia_sp_5_7_47FAA_biomass525 at 0x158edb53d30>: {'charge':
1.1166217999999846,
'C': -41.42309740000013,
'H': -63.27387099999998,
'N': -10.952010200000075,
'O': -15.85401660000002,
'P': -1.1706787999999961,
'S': -0.2695576,
'X': -2.0,
'Ca': -0.0078094,
'Cl': -0.0078094,
'Co': -0.0078094,
'Cu': -0.0078094,
'Fe': -0.0156188,
'K': -0.0078094,
'Mg': -0.0078094,
'Mn': -0.0078094,
'Zn': -0.0078094},
<Reaction Rothia_mucilaginosa_DY_18_DHNAOT_Rothia_mucilaginosa_DY_18_c at
0x158edbf82e0>: {'charge': 2.0},
<Reaction Rothia_mucilaginosa_DY_18_DM_2HYMEPH_Rothia_mucilaginosa_DY_18_c at
0x158edbf80d0>: {'C': -7.0,
'H': -8.0,
'O': -2.0},
<Reaction Rothia_mucilaginosa_DY_18_DM_5MTR_Rothia_mucilaginosa_DY_18_c at
0x158edc00730>: {'C': -6.0,
'H': -12.0,
'O': -4.0,
'S': -1.0},
<Reaction Rothia_mucilaginosa_DY_18_DM_HQN_Rothia_mucilaginosa_DY_18_c at
0x158edc00190>: {'C': -6.0,
'H': -6.0,
'O': -2.0},
<Reaction Rothia_mucilaginosa_DY_18_DM_dhptd_Rothia_mucilaginosa_DY_18_c at
0x158edc007f0>: {'C': -5.0,
'H': -8.0,
'O': -4.0},

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<Reaction Rothia_mucilaginosa_DY_18_DM_hcys_L_Rothia_mucilaginosa_DY_18_c at
0x158edc00880>: {'C': -4.0,
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  'N': -1.0,
  'O': -2.0,
  'S': -1.0},
<Reaction Rothia_mucilaginosa_DY_18_EX_biomass_e_Rothia_mucilaginosa_DY_18_c at
0x158edc1aa90>: {'X': -1.0},
<Reaction Rothia_mucilaginosa_DY_18_drepllication_Rothia_mucilaginosa_DY_18_c at
0x158edd6b880>: {'X': 1.0},
<Reaction Rothia_mucilaginosa_DY_18_pbiosynthesis_Rothia_mucilaginosa_DY_18_c
at 0x158edd6bbb0>: {'X': 1.0},
<Reaction Rothia_mucilaginosa_DY_18_rtranscription_Rothia_mucilaginosa_DY_18_c
at 0x158edd7bfd0>: {'X': 1.0},
<Reaction Rothia_mucilaginosa_DY_18_biomass429 at 0x158edd7bf40>: {'charge':
0.85564900000000481,
  'C': -39.3429950000000066,
  'H': -62.78079350000004,
  'N': -8.5739184999999937,
  'O': -14.3108610000000338,
  'P': -0.81207550000000145,
  'S': -0.222525,
  'X': -2.0,
  'Co': -0.0030965,
  'Ca': -0.0030965,
  'Cl': -0.0030965,
  'Cu': -0.0030965,
  'Fe': -0.012386,
  'K': -0.0030965,
  'Mg': -0.0030965,
  'Mn': -0.0030965,
  'Zn': -0.0030965},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_DHNAOT_Staphylococcc
us_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ede62d90>: {'charge': 2.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_DM_5MTR_Staphylococ
cus_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ede6ae80>: {'C': -6.0,
  'H': -12.0,
  'O': -4.0,
  'S': -1.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_DM_dhptd_Staphyloco
ccus_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ede6a190>: {'C': -5.0,
  'H': -8.0,
  'O': -4.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_DM_hcys_L_Staphyloc
occus_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ede6af10>: {'C': -4.0,
  'H': -9.0,
  'N': -1.0,

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'O': -2.0,
'S': -1.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_EX_biomass_e_Staphy
lococcus_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ede955e0>: {'X': -1.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_TECA4S_Staphylococc
us_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ee04a4f0>: {'charge': -30.0,
'C': -420.0,
'H': -752.0,
'N': -30.0,
'O': -391.0,
'P': -30.0,
'X': 1.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_TECAAE_Staphylococc
us_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ee04ac70>: {'C': -286.0,
'H': -477.0,
'N': -47.0,
'O': -238.0,
'P': -46.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_TECAGE_Staphylococc
us_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ee04ad30>: {'charge': 45.0,
'C': -421.0,
'H': -747.0,
'N': -2.0,
'O': -463.0,
'P': -46.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_TECAUE_Staphylococc
us_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ee04adf0>: {'charge': 45.0,
'C': -151.0,
'H': -297.0,
'N': -2.0,
'O': -238.0,
'P': -46.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_TEICH45_Staphylococ
cus_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ee04aeb0>: {'charge': 45.0,
'C': -630.0,
'H': -945.0,
'N': -45.0,
'O': -630.0,
'P': -45.0,
'X': 1.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_drepliation_Staphy
lococcus_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ee080ac0>: {'X': 1.0},
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ylococcus_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ee080c70>: {'X': 1.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_rtranscription_Stap
hylococcus_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ee099c70>: {'X': 1.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_sink_PGPm1_Staphylo

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coccus_aureus_subsp_aureus_USA300_FPR3757_c at 0x158ee099d30>: {'X': -1.0},
<Reaction Staphylococcus_aureus_subsp_aureus_USA300_FPR3757_biomass042 at
0x158ee099f10>: {'charge': -81.86880639999987,
  'C': -35.038135600000125,
  'H': 26.146923000000044,
  'N': -7.3513556000000002,
  'O': 68.978846699999962,
  'P': -0.93873730000000402,
  'S': -0.21809219999999996,
  'X': -2.0018063,
  'Co': -0.0079397,
  'Ca': -0.0079397,
  'Cl': -0.0079397,
  'Cu': -0.0079397,
  'Fe': -0.0317588,
  'K': -0.0079397,
  'Mg': -0.0079397,
  'Mn': -0.0079397,
  'Zn': -0.0079397},
<Reaction
Streptococcus_sanguinis_SK36_DM_2HYMEPH_Streptococcus_sanguinis_SK36_c at
0x158ee16fbe0>: {'C': -7.0,
  'H': -8.0,
  'O': -2.0},
<Reaction Streptococcus_sanguinis_SK36_DM_5MTR_Streptococcus_sanguinis_SK36_c
at 0x158ee16f160>: {'C': -6.0,
  'H': -12.0,
  'O': -4.0,
  'S': -1.0},
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0x158ee16fbb0>: {'C': -6.0,
  'H': -6.0,
  'O': -2.0},
<Reaction Streptococcus_sanguinis_SK36_DM_dhptd_Streptococcus_sanguinis_SK36_c
at 0x158ee16fe80>: {'C': -5.0,
  'H': -8.0,
  'O': -4.0},
<Reaction Streptococcus_sanguinis_SK36_DM_hcys_L_Streptococcus_sanguinis_SK36_c
at 0x158ee16ff10>: {'C': -4.0,
  'H': -9.0,
  'N': -1.0,
  'O': -2.0,
  'S': -1.0},
<Reaction
Streptococcus_sanguinis_SK36_EX_biomass_e_Streptococcus_sanguinis_SK36_c at
0x158ee189f70>: {'X': -1.0},
<Reaction Streptococcus_sanguinis_SK36_SHCHCC2_Streptococcus_sanguinis_SK36_c

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at 0x158ee2ea250>: {'charge': -2.0},
  <Reaction Streptococcus_sanguinis_SK36_TECA4S_Streptococcus_sanguinis_SK36_c at
0x158ee44c190>: {'charge': -30.0,
  'C': -420.0,
  'H': -752.0,
  'N': -30.0,
  'O': -391.0,
  'P': -30.0,
  'X': 1.0},
  <Reaction Streptococcus_sanguinis_SK36_TECAAE_Streptococcus_sanguinis_SK36_c at
0x158ee4539a0>: {'C': -286.0,
  'H': -477.0,
  'N': -47.0,
  'O': -238.0,
  'P': -46.0},
  <Reaction Streptococcus_sanguinis_SK36_TECAGE_Streptococcus_sanguinis_SK36_c at
0x158ee453a60>: {'charge': 45.0,
  'C': -421.0,
  'H': -747.0,
  'N': -2.0,
  'O': -463.0,
  'P': -46.0},
  <Reaction Streptococcus_sanguinis_SK36_TECAUE_Streptococcus_sanguinis_SK36_c at
0x158ee453b20>: {'charge': 45.0,
  'C': -151.0,
  'H': -297.0,
  'N': -2.0,
  'O': -238.0,
  'P': -46.0},
  <Reaction
Streptococcus_sanguinis_SK36_drepllication_Streptococcus_sanguinis_SK36_c at
0x158ee480cd0>: {'X': 1.0},
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Streptococcus_sanguinis_SK36_pbiosynthesis_Streptococcus_sanguinis_SK36_c at
0x158ee480250>: {'X': 1.0},
  <Reaction
Streptococcus_sanguinis_SK36_rtranscription_Streptococcus_sanguinis_SK36_c at
0x158ee496730>: {'X': 1.0},
  <Reaction
Streptococcus_sanguinis_SK36_sink_PGPm1_Streptococcus_sanguinis_SK36_c at
0x158ee496fd0>: {'X': -1.0},
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-81.86883519999986,
  'C': -35.03518620000009,
  'H': 26.14989040000043,
  'N': -7.354207799999981,
  'O': 68.97894029999964,

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'P': -0.9387157000000436,
'S': -0.21809219999999996,
'X': -2.0018063,
'Co': -0.0079397,
'Ca': -0.0079397,
'Cl': -0.0079397,
'Cu': -0.0079397,
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'K': -0.0079397,
'Mg': -0.0079397,
'Mn': -0.0079397,
'Zn': -0.0079397},
<Reaction
Veillonella_atypica_ACS_049_V_Sch6_DHNAOT_Veillonella_atypica_ACS_049_V_Sch6_c
at 0x158ee53e910>: {'charge': 2.0},
<Reaction
Veillonella_atypica_ACS_049_V_Sch6_DM_dhptd_Veillonella_atypica_ACS_049_V_Sch6_c
at 0x158ee546e20>: {'C': -5.0,
'H': -8.0,
'O': -4.0},
<Reaction Veillonella_atypica_ACS_049_V_Sch6_DM_hcys_L_Veillonella_atypica_ACS_
049_V_Sch6_c at 0x158ee5462b0>: {'C': -4.0,
'H': -9.0,
'N': -1.0,
'O': -2.0,
'S': -1.0},
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CS_049_V_Sch6_c at 0x158ee55fb80>: {'X': -1.0},
<Reaction
Veillonella_atypica_ACS_049_V_Sch6_SHCHCC2_Veillonella_atypica_ACS_049_V_Sch6_c
at 0x158ee692460>: {'charge': -2.0},
<Reaction
Veillonella_atypica_ACS_049_V_Sch6_TECA4S_Veillonella_atypica_ACS_049_V_Sch6_c
at 0x158ee6a7580>: {'charge': -30.0,
'C': -420.0,
'H': -752.0,
'N': -30.0,
'O': -391.0,
'P': -30.0,
'X': 1.0},
<Reaction
Veillonella_atypica_ACS_049_V_Sch6_TECAAE_Veillonella_atypica_ACS_049_V_Sch6_c
at 0x158ee6a7d00>: {'C': -286.0,
'H': -477.0,
'N': -47.0,
'O': -238.0,
'P': -46.0},

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<Reaction
Veillonella_atypica_ACS_049_V_Sch6_TECAGE_Veillonella_atypica_ACS_049_V_Sch6_c
at 0x158ee6a7dc0>: {'charge': 45.0,
  'C': -421.0,
  'H': -747.0,
  'N': -2.0,
  'O': -463.0,
  'P': -46.0},
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Veillonella_atypica_ACS_049_V_Sch6_TECAUE_Veillonella_atypica_ACS_049_V_Sch6_c
at 0x158ee6a7e80>: {'charge': 45.0,
  'C': -151.0,
  'H': -297.0,
  'N': -2.0,
  'O': -238.0,
  'P': -46.0},
<Reaction Veillonella_atypica_ACS_049_V_Sch6_drepllication_Veillonella_atypica_A
CS_049_V_Sch6_c at 0x158ee6caac0>: {'X': 1.0},
<Reaction Veillonella_atypica_ACS_049_V_Sch6_pbiosynthesis_Veillonella_atypica_
ACS_049_V_Sch6_c at 0x158ee6cab80>: {'X': 1.0},
<Reaction Veillonella_atypica_ACS_049_V_Sch6_rtranscription_Veillonella_atypica
_ACS_049_V_Sch6_c at 0x158ee6dfbb0>: {'X': 1.0},
<Reaction Veillonella_atypica_ACS_049_V_Sch6_sink_PGPm1_Veillonella_atypica_ACS
_049_V_Sch6_c at 0x158ee6dfd60>: {'X': -1.0},
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{'charge': -81.86882719999998,
  'C': -35.036401200000036,
  'H': 26.1486704000000327,
  'N': -7.3530197999999996,
  'O': 68.97891429999997,
  'P': -0.93872170000000568,
  'S': -0.21809219999999996,
  'X': -2.0018063,
  'Co': -0.0079397,
  'Ca': -0.0079397,
  'Cl': -0.0079397,
  'Cu': -0.0079397,
  'Fe': -0.0317588,
  'K': -0.0079397,
  'Mg': -0.0079397,
  'Mn': -0.0079397,
  'Zn': -0.0079397}}

```

1.2 Saving and loading community models

Community model objects can be saved and loaded into SBML files. This is different from the other available option to save the cobra model of the community model objects, as the abundance

fractions of the organisms are written into the file as well. Saving and loading the community model can be done like this:

```
[13]: com_model_obj.save("../data/toy/output/henson_com_model.xml")
```

```
[14]: com_model_obj_loaded = pycomo.CommunityModel.load("../data/toy/output/  
↪henson_com_model.xml")
```

```
[15]: com_model_obj_loaded.community_model.summary()
```

```
[15]: <cobra.summary.model_summary.ModelSummary at 0x1593e81c220>
```

1.3 Analysis of community models

Work in progress.