Equations S3. *GMA mass balance equations for labelad pools.*

$$dL_1/dt = l_{12,1} - l_{1,2}$$
$$dL_2/dt = \left(l_{1,2} + l_{3,2} + l_{4,2}\right) - \left(l^a_{2,3} + l_{2,4} + l_{2,5}\right)\ ^*$$
$$dL_3/dt = \left(l^c_{2,3} + l_{8,3} + l_{18,3} + l_{19,3}\right) - \left(l_{3,2} + l_{3,7} + l^a_{3,8}\right)$$
$$dL_4/dt = l_{2,4} - \left(l_{4,2} + l_{4,17}\right)$$
$$dL_5/dt = \left(l_{2,5} + l_{6,5} + l_{7,5}\right) - \left(l_{5,6} + l^a_{5,7}\right)$$
$$dL_6/dt = l_{5,6} - \left(l_{6,5} + l_{6,17}\right)$$
$$dL_7/dt = \left(l_{3,7} + l^c_{5,7} + l_{8,7} + l_{18,7} + l_{19,7}\right) - \left(l_{7,5} + l^a_{7,8} + l_{7,43}\right)$$
$$dL_8/dt = \left(l^c_{3,8} + l^c_{7,8} + l_{20,8}\right) - \left(l_{8,3} + l_{8,7} + l_{8,18} + l_{8,20}\right)$$
$$dL_9/dt = l_{11,9} - \left(l_{9,10} + l_{9,15}\right)$$
$$dL_{10}/dt = l_{9,10} - l_{10,56}$$
$$dL_{11}/dt = l_{12,11} - \left(l_{11,9} + l_{11,14}\right)$$
$$dL_{12}/dt = \left(l_{4,17} + l_{6,17} + l^c_{24,12}\right) - \left(l_{12,1} + l_{12,11} + l^a_{12,23} + l_{12,148}\right)$$
$$dL_{14}/dt = \left(l^b_{3,8} + l^b_{7,8} + l_{11,14} + l^b_{18,19}\right) - \left(l_{14,142} + l_{14,145}\right)$$
$$dL_{15}/dt = l_{9,15} - \left(l^b_{3,8} + l^b_{7,8} + l_{15,44} + l^b_{18,19}\right)$$
$$dL_{17}/dt = \left(l_{4,17} + l_{6,17}\right) - l_{14,145}$$
$$dL_{18}/dt = \left(l_{8,18} + l_{21,18}\right) - \left(l_{18,3} + l_{18,7} + l^a_{18,19} + l_{18,21}\right)$$
$$dL_{19}/dt = \left(l^c_{18,19} + l_{22,19}\right) - \left(l_{19,3} + l_{19,7} + l_{19,22}\right)$$
$$dL_{20}/dt = l_{8,20} - l_{20,8}$$
$$dL_{21}/dt = l_{18,21} - l_{21,18}$$
$$dL_{22}/dt = l_{19,22} - l_{22,19}$$
$$dL_{23}/dt = l^c_{12,23} - \left(l^b_{2,3} + l^b_{5,7}\right)$$
$$dL_{24}/dt = l_{25,24} - \left(l^b_{12,23} + l^a_{24,12}\right)$$
$$dL_{25}/dt = \left(l_{38,25} + l_{124,25}\right) - \left(l^b_{24,12} + l_{25,24}\right)$$
$$dL_{26}/dt = l_{25,26} - l_{26,27}$$
$$dL_{27}/dt = l_{26,27} - l_{27,28}$$
$$dL_{28}/dt = l_{27,28} - \left(l_{28,29} + l_{28,179}\right)$$
$$dL_{29}/dt = l_{28,29} - l_{29,30}$$
$$dL_{30}/dt = \left(l_{29,30} + l_{33,30}\right) - \left(l_{30,31} + l_{30,33}\right)$$
$$dL_{31}/dt = \left(l_{30,31} + l_{34,31}\right) - \left(l_{31,32} + l_{31,34}\right)$$
$$dL_{32}/dt = \left(l_{31,32} + l_{35,32} + l_{37,32} + l_{39,32}\right) - \left(l_{32,35} + l_{32,37} + l_{32,39} + l_{32,186}\right)$$
$$dL_{33}/dt = l_{30,33} - l_{33,30}$$
$$dL_{34}/dt = l_{31,34} - l_{34,31}$$
$$dL_{35}/dt = \left(l_{32,35} + l_{40,35}\right) - \left(l_{35,32} + l_{35,40}\right)$$
$$dL_{36}/dt = \left(l_{37,36} + l_{39,36}\right) - \left(l^a_{36,37} + l^b_{36,37} + l^c_{36,37} + l_{36,39}\right)$$

$$dL_{37}/dt = \left(l_{32,37} + l^{a}_{36,37} + l^{b}_{36,37} + l^{c}_{36,37}\right) - \left(l_{37,32} + l_{37,36}\right)$$
$$dL_{38}/dt = l_{125,38} - l_{38,25}$$
$$dL_{39}/dt = \left(l_{42,39} + l_{36,39} + l_{40,39}\right) - \left(l_{39,32} + l_{39,36}\right)$$
$$dL_{40}/dt = l_{35,40} - \left(l_{40,35} + l_{40,39}\right)$$

$^{(*)}$ A superscript indicates deviations from the total pool; the method automatically computes equations for the labeled fractions.

Tracer method: Mathematical approach to modeling tracer dynamics

To characterize the movement and distribution of a radioactive tracer throughout the sphingolipid pathway, simulations were performed using a method specifically developed for this purpose [1]. This method models the dynamics of total (labeled plus unlabeled) metabolites and in a second and third set of equations distributes material between labeled and unlabeled fractions (see [1] and main manuscript for details of the method).

Tracer equations

In Equations S3 and S4, the labeled metabolites serine (L_{13}) and inositol (L_{16}) are not included because they never receive label in radioactive acetate (L_{125}) experiments. For the same reason, the time independent variables palmitate (L_{158}) and pyruvate (L_{124}) are not included in Equations S3 and S4.

References.

1. Voit EO, Alvarez-Vasquez F, Sims KJ (2004) Analysis of dynamic labeling data. Math Biosci 191: 83-99.