

Table S24 - IPA biological functions of the Morula to Blast mega-group

Categories	Functions Annotation	p-value ^a	Z-score ^b	Activation State	Total DEGs
Organismal Survival	Organismal death	1.09E-03	-4.876	Inhibited	81
Cell Death and Survival	Cell death	1.53E-04	-3.864	Inhibited	175
Cell Morphology, Cellular Assembly and Organization, Cellular Function and Maintenance	Formation of cellular protrusions	6.51E-06	3.74	Activated	51
Cellular Assembly and Organization, Cellular Function and Maintenance	Microtubule dynamics	3.84E-07	3.717	Activated	70
Cell Death and Survival	Necrosis	8.47E-04	-3.705	Inhibited	148
Cellular Assembly and Organization, Cellular Function and Maintenance	Organization of cytoskeleton	5.77E-07	3.665	Activated	74
Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Quantity of steroid	3.09E-03	3.118	Activated	25
Cell Death and Survival	Apoptosis	3.22E-05	-3.017	Inhibited	140
Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Concentration of sterol	1.69E-03	2.78	Activated	18
Cell Morphology	Sprouting	6.19E-04	2.745	Activated	30
Cellular Assembly and Organization, Cellular Function and Maintenance	Organization of actin cytoskeleton	9.18E-04	2.728	Activated	13
Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Concentration of lipid	9.17E-04	2.716	Activated	46
Cell Morphology, Cellular Development	Branching of cells	4.37E-04	2.714	Activated	30
Cellular Growth and Proliferation	Outgrowth of cells	1.66E-03	2.658	Activated	30
Carbohydrate Metabolism, Small Molecule Biochemistry	Synthesis of D-glucose	2.84E-03	2.633	Activated	9
Cellular Development, Cellular Growth and Proliferation, Nervous System Development and Function, Tissue Development	Outgrowth of neurites	3.23E-03	2.591	Activated	27
Tissue Morphology	Quantity of cells	1.61E-05	2.554	Activated	94
Cell Morphology, Cellular Assembly and Organization, Cellular Function and Maintenance	Reorganization of actin cytoskeleton	7.06E-05	2.538	Activated	12
Cellular Movement	Cell movement of lung cancer cell lines	1.13E-04	2.518	Activated	15
Cellular Movement	Cell movement	7.69E-10	2.431	Activated	145
Cell Morphology, Cellular Assembly and Organization, Cellular Development, Cellular Function and Maintenance, Cellular Growth and Proliferation, Nervous System Development and Function, Organismal Development, Tissue Development	Branching of neurons	1.91E-03	2.383	Activated	23
Cellular Movement	Migration of lung cancer cell lines	1.97E-04	2.359	Activated	13
Cell-To-Cell Signaling and Interaction	Interaction of tumor cell lines	8.14E-07	2.335	Activated	39
Cellular Assembly and Organization, Cellular Function and Maintenance	Quantity of cellular protrusions	1.59E-03	2.295	Activated	14
Cellular Development, Cellular Growth and Proliferation	Cell proliferation of tumor cell lines	3.14E-04	2.269	Activated	105
Connective Tissue Development and Function, Tissue Morphology	Quantity of connective tissue cells	3.03E-05	2.237	Activated	19
Molecular Transport	Transport of molecule	7.75E-05	2.212	Activated	55
Cellular Movement	Migration of cells	2.99E-08	2.198	Activated	127
Cellular Movement	Cell movement of sarcoma cell lines	3.01E-04	2.198	Activated	12
Cell Morphology, Cellular Assembly and Organization, Cellular Function and Maintenance	Reorganization of cytoskeleton	6.39E-04	2.139	Activated	15
Cell-To-Cell Signaling and Interaction	Binding of tumor cell lines	2.35E-06	2.118	Activated	37
Cellular Movement	Chemotaxis	2.67E-05	2.093	Activated	37
Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Accumulation of lipid	3.15E-03	-2.031	Inhibited	23
Cell Death and Survival	Cell death of connective tissue cells	1.61E-03	-1.969	Inhibited	40

Carbohydrate Metabolism, Molecular Transport	Quantity of glycogen	5.28E-04	-1.969	Inhibited	8
Cell Death and Survival	Anoikis of carcinoma cell lines	1.12E-03	-1.964	Inhibited	4
Cell-To-Cell Signaling and Interaction	Adhesion of neuroglia	4.72E-04	1.934		4
Cellular Development, Cellular Growth and Proliferation	Cell proliferation of ovarian cancer cell lines	7.85E-06	1.925		17
Cellular Assembly and Organization, Lipid Metabolism, Small Molecule Biochemistry	Accumulation of lipid droplets	4.46E-05	-1.91		8
Organ Morphology, Skeletal and Muscular System Development and Function, Tissue Morphology	Quantity of muscle cells	1.38E-03	1.905		10
Cellular Movement, Skeletal and Muscular System Development and Function	Migration of smooth muscle cells	1.04E-03	1.894		14
Cell Morphology, Cellular Assembly and Organization, Cellular Development, Cellular Function and Maintenance, Cellular Growth and Proliferation, Embryonic Development, Nervous System Development and Function, Organismal Development, Tissue Development	Branching of axons	1.83E-03	1.877		9
Cell-To-Cell Signaling and Interaction, Connective Tissue Development and Function	Binding of fibroblast cell lines	8.93E-04	1.87		11
Embryonic Development, Organ Development, Organismal Development, Reproductive System Development and Function, Tissue Development	Formation of mammary gland	5.25E-04	1.842		14
Cellular Movement	Cell movement of tumor cell lines	2.50E-06	1.837		74
Cellular Development, Cellular Growth and Proliferation	Cell proliferation of bone cancer cell lines	1.50E-04	1.794		14
Cardiovascular System Development and Function, Cellular Movement	Migration of endothelial cells	7.32E-05	1.748		26
Cellular Movement	Cell movement of hepatoma cell lines	1.03E-03	1.742		11
Cell-To-Cell Signaling and Interaction	Binding of breast cancer cell lines	3.53E-05	1.71		12
Hematological System Development and Function, Tissue Morphology	Quantity of leukocytes	3.08E-03	1.685		44
Cellular Movement	Cell movement of fibrosarcoma cell lines	2.01E-04	1.664		8
Skeletal and Muscular System Development and Function	Quantity of muscle	9.58E-04	1.597		11
Cellular Movement, Skeletal and Muscular System Development and Function	Cell movement of vascular smooth muscle cells	8.12E-04	1.578		12
Cell Death and Survival, Nervous System Development and Function	Cell viability of neuroglia	1.42E-03	1.552		7
Cell Death and Survival	Anoikis	1.74E-03	-1.533		11
Cellular Movement	Invasion of tumor cell lines	3.89E-06	1.446		60
Cellular Assembly and Organization, Cellular Function and Maintenance, Nervous System Development and Function, Tissue Morphology	Quantity of neurites	4.96E-04	1.42		10
Skeletal and Muscular System Development and Function	Quantity of bone	2.44E-04	1.418		14
Connective Tissue Development and Function, Skeletal and Muscular System Development and Function, Tissue Morphology	Quantity of osteoclasts	1.57E-03	1.408		9
Cellular Movement	Migration of fibrosarcoma cell lines	2.76E-03	1.387		6
Lipid Metabolism, Small Molecule Biochemistry	Binding of phospholipid	1.14E-03	1.387		5
Cellular Growth and Proliferation, Hair and Skin Development and Function	Colony formation of epithelial cell lines	1.36E-03	-1.387		5
Cell Morphology, Cellular Assembly and Organization, Cellular Development, Cellular Function and Maintenance, Cellular Growth and Proliferation, Nervous System Development and Function, Organismal Development, Tissue Development	Axonogenesis	2.65E-03	1.363		12

Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Quantity of glycosylceramide	3.64E-05	1.342	6
Cell-To-Cell Signaling and Interaction	Attachment of connective tissue cells	3.35E-04	1.342	5
Cardiovascular System Development and Function, Cellular Movement	Cell movement of endothelial cells	3.40E-05	1.318	29
Cellular Movement	Invasion of cells	1.90E-06	1.273	73
Connective Tissue Development and Function, Skeletal and Muscular System Development and Function, Tissue Morphology	Quantity of bone cells	1.05E-04	1.265	13
Cellular Movement	Migration of tumor cell lines	2.49E-07	1.257	67
Organismal Development, Reproductive System Development and Function	Development of reproductive system	1.29E-03	1.255	26
Molecular Transport	Transport of cation	1.59E-03	1.203	10
Cellular Movement, Immune Cell Trafficking	Leukocyte migration	1.01E-03	1.172	56
Cellular Movement, Reproductive System Development and Function	Cell movement of breast cell lines	2.38E-04	1.154	12
Cellular Movement	Migration of prostate cancer cell lines	2.94E-06	1.152	16
Cellular Movement	Cell movement of skin cancer cell lines	2.90E-03	1.067	5
Cellular Movement	Cell movement of epithelial cells	1.36E-03	1.046	14
Cellular Movement	Cell movement of blood cells	8.20E-04	1.041	57
Connective Tissue Development and Function, Skeletal and Muscular System Development and Function, Tissue Morphology	Quantity of osteoblasts	2.76E-04	1.026	7
Cell-To-Cell Signaling and Interaction	Adhesion of tumor cell lines	4.82E-06	1.023	30
Behavior	Exploratory behavior	3.32E-03	-1.015	5
Organismal Functions, Tissue Morphology	Healing of epithelial tissue	8.59E-04	1	4
Cell Morphology, Embryonic Development	Shape change of embryonic cell lines	2.20E-03	1	6
Cell Cycle, Gene Expression	Binding of DNA	3.15E-03	0.962	35
Cell Death and Survival	Cell death of sarcoma cell lines	1.54E-03	-0.959	19
Cardiovascular System Development and Function	Development of vasculature	1.44E-04	0.956	54
Cell Death and Survival	Apoptosis of endothelial cell lines	2.95E-04	-0.956	8
Cardiovascular System Development and Function, Organismal Development	Angiogenesis	9.77E-04	0.954	49
Cellular Development, Cellular Growth and Proliferation, Embryonic Development, Organ Development, Organismal Development, Skeletal and Muscular System Development and Function, Tissue Development	Formation of muscle cells	3.76E-04	0.896	13
Cellular Movement, Reproductive System Development and Function	Migration of breast cell lines	3.29E-03	0.895	8
Cell-To-Cell Signaling and Interaction	Adhesion of breast cancer cell lines	6.74E-04	0.863	9
Cellular Movement	Cell movement of prostate cancer cell lines	2.06E-06	0.839	18
Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Quantity of cerebroside	5.75E-05	0.832	5
Cellular Movement	Cell movement of cervical cancer cell lines	1.53E-03	-0.801	11
Cell Death and Survival	Cell death of pericytes	1.60E-03	-0.776	5
Cellular Assembly and Organization	Quantity of filaments	8.48E-05	0.774	15
Cardiovascular System Development and Function, Organismal Development	Vasculogenesis	4.96E-04	0.766	45
Lipid Metabolism, Small Molecule Biochemistry, Vitamin and Mineral Metabolism	Steroid metabolism	3.45E-03	0.763	13
Embryonic Development, Organismal Development	Development of body trunk	3.67E-04	0.734	46
Endocrine System Development and Function	Insulin sensitivity index	3.42E-03	-0.728	6
Lipid Metabolism, Small Molecule Biochemistry, Vitamin and Mineral Metabolism	Metabolism of terpenoid	2.22E-03	0.721	15
Cell Death and Survival	Apoptosis of pheochromocytoma cell lines	1.98E-03	-0.693	9

Cellular Assembly and Organization	Development of cytoplasm	2.40E-04	0.688	28
Cellular Compromise	Calcification of cells	1.79E-03	0.686	4
Cell-To-Cell Signaling and Interaction, Cellular Assembly and Organization	Cell-cell contact	3.67E-05	0.658	37
Organismal Development	Development of genitourinary system	1.50E-03	0.651	33
Carbohydrate Metabolism	Binding of carbohydrate	1.83E-03	0.647	9
Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Quantity of glycosphingolipid	2.70E-03	0.636	10
Nervous System Development and Function, Tissue Morphology	Quantity of neurons	1.42E-03	0.617	26
Cardiovascular System Development and Function, Hematological System Development and Function	Blood pressure	1.49E-03	-0.61	17
Cellular Assembly and Organization	Formation of cytoskeleton	3.97E-04	0.602	24
Carbohydrate Metabolism	Gluconeogenesis	2.03E-04	0.6	7
Molecular Transport	Transport of Na+	1.88E-03	-0.6	5
Cardiovascular System Development and Function, Cell-To-Cell Signaling and Interaction	Binding of endothelial cells	9.07E-04	0.591	17
Cell Death and Survival	Cell death of endothelial cell lines	9.53E-05	-0.573	9
Cellular Assembly and Organization, Tissue Development	Formation of filaments	1.03E-03	0.56	24
Cellular Movement, Hair and Skin Development and Function	Cell movement of epithelial cell lines	5.58E-04	0.547	14
Cardiovascular System Development and Function, Cellular Development, Cellular Growth and Proliferation, Connective Tissue Development and Function, Digestive System Development and Function, Hepatic System Development and Function, Organ Development, Organismal Development, Tissue Development	Proliferation of hepatic stellate cells	1.14E-03	0.522	7
Cardiovascular System Development and Function, Cellular Development, Cellular Function and Maintenance, Cellular Growth and Proliferation, Organismal Development, Tissue Development	Endothelial cell development	5.80E-04	0.503	24
Cellular Assembly and Organization	Accumulation of lysosome	2.01E-04	-0.489	5
Embryonic Development	Tubulogenesis	1.14E-03	-0.378	7
Cellular Function and Maintenance	Cellular homeostasis	9.74E-04	0.354	70
Cell-To-Cell Signaling and Interaction, Cellular Assembly and Organization	Quantity of actin stress fibers	2.47E-04	0.342	9
Cellular Assembly and Organization	Remodeling of actin filaments	2.59E-05	0.314	5
Carbohydrate Metabolism, Molecular Transport, Small Molecule Biochemistry	Concentration of D-glucose	1.91E-03	0.292	18
Cellular Development, Cellular Growth and Proliferation, Reproductive System Development and Function	Cell proliferation of breast cell lines	1.45E-03	0.284	13
Cellular Function and Maintenance	Engulfment of cells	8.14E-04	0.251	28
Cellular Movement	Migration of cervical cancer cell lines	1.83E-03	-0.229	9
Cellular Growth and Proliferation, Nervous System Development and Function, Organ Development	Proliferation of cerebral cortex cells	3.26E-03	0.225	4
Carbohydrate Metabolism	Quantity of carbohydrate	2.90E-03	0.222	29
Cell Death and Survival	Cell death of eye cells	3.05E-03	0.216	8
Digestive System Development and Function	Development of digestive system	1.14E-03	-0.2	17

Cardiovascular System Development and Function, Cellular Development, Cellular Function and Maintenance, Cellular Growth and Proliferation, Organismal Development, Tissue Development	Proliferation of endothelial cells	9.39E-04	0.167	21
Cellular Assembly and Organization, Tissue Development	Fibrogenesis	1.85E-04	0.116	28
Hematological System Development and Function, Tissue Morphology	Quantity of myeloid cells	2.76E-03	0.11	25
Cardiovascular System Development and Function, Cell-To-Cell Signaling and Interaction	Binding of vascular endothelial cells	2.02E-03	0.106	12
Cellular Movement	Cell movement of dermal cells	3.06E-03	-0.103	10
Cardiovascular System Development and Function, Cellular Development, Cellular Growth and Proliferation, Organ Development, Skeletal and Muscular System Development and Function, Tissue Development	Proliferation of vascular smooth muscle cells	3.62E-03	0.086	13
Cell-To-Cell Signaling and Interaction, Cellular Assembly and Organization, Skeletal and Muscular System Development and Function	Fusion of muscle cell lines	2.36E-04	-0.059	6
Molecular Transport	Transport of metal	1.23E-03	-0.04	14
Behavior	Behavior	4.25E-04	-0.033	40
Cellular Assembly and Organization	Quantity of actin filaments	1.76E-04	0	10
Cell Death and Survival	Cell death of heart cell lines	2.47E-03		6
Cardiovascular System Development and Function	Morphology of cardiovascular system	1.68E-04		34
Skeletal and Muscular System Development and Function	Morphology of muscle	1.15E-03		23
Cellular Movement	Dissemination of prostate cancer cell lines	5.10E-04		3
Cellular Assembly and Organization	Quantity of macropinosomes	1.37E-03		3
Cardiovascular System Development and Function	Morphology of vessel	1.96E-03		11
Digestive System Development and Function	Morphology of digestive system	9.11E-04		20
Cardiovascular System Development and Function, Tissue Morphology	Morphology of blood vessel	1.70E-03		10
Embryonic Development, Organismal Development, Tissue Morphology	Morphology of visceral endoderm	2.61E-04		3
Cell Morphology, Organ Morphology, Skeletal and Muscular System Development and Function, Tissue Morphology	Area of muscle cells	1.14E-03		5
Cardiovascular System Development and Function, Cell Morphology, Skeletal and Muscular System Development and Function	Relengthening of cardiomyocytes	9.09E-04		2
Molecular Transport	Quantity of urea	5.27E-04		5
Cellular Movement	Invasion of myeloma cell lines	2.67E-03		2
Cellular Growth and Proliferation, Connective Tissue Development and Function	Proliferation of stromal cell lines	2.67E-03		2
Cell-To-Cell Signaling and Interaction, Cellular Assembly and Organization, Cellular Function and Maintenance, Nervous System Development and Function, Tissue Development	Function of synapse	1.43E-03		4
Organismal Development	Morphology of body cavity	7.06E-05		50
Cellular Assembly and Organization, Tissue Development	Formation of membrane tubule	1.37E-03		3
Cell Morphology, Reproductive System Development and Function	Whole-cell conductance of oocytes	2.61E-04		3
Lipid Metabolism, Small Molecule Biochemistry	Recruitment of phospholipid	2.67E-03		2
Behavior	Active avoidance response	2.67E-03		2

Tissue Morphology	Density of microglia	1.07E-04	3
Tissue Morphology	Density of macrophages	5.21E-05	4
Connective Tissue Development and Function, Skeletal and Muscular System Development and Function, Tissue Development, Tissue Morphology	Size of medullary cavity	2.67E-03	2
Digestive System Development and Function, Organ Morphology, Organismal Development	Morphology of pancreas	1.87E-03	8
Cell Morphology	Size of cells	6.16E-04	32
Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Quantity of glucosylceramide	2.00E-03	3
Cardiovascular System Development and Function, Organ Morphology, Organismal Development	Morphology of heart	1.08E-03	28
Digestive System Development and Function, Organ Morphology, Organismal Development	Size of pancreas	3.42E-03	6
Cell Morphology, Cellular Assembly and Organization	Size of lysosome	2.80E-03	3
Cell Morphology, Organ Morphology, Skeletal and Muscular System Development and Function, Tissue Morphology	Morphology of muscle cells	1.89E-03	20
Cell-To-Cell Signaling and Interaction, Skeletal and Muscular System Development and Function	Adhesion of smooth muscle cells	8.59E-04	4
Cell Morphology	Shape change of endothelial cell lines	4.23E-04	5
Digestive System Development and Function, Embryonic Development, Organ Development, Organismal Development	Tooth development	1.87E-03	8
Cell Morphology	Morphology of prostate cell lines	1.37E-03	3
Cell Morphology	Area of cells	4.87E-05	11
Cell Morphology	Enlargement of cells	3.84E-06	31
Cell Cycle	Cell division of tumor cell lines	2.22E-03	4
Cellular Movement	Haptotaxis of prostate cancer cell lines	9.09E-04	2
Amino Acid Metabolism, Molecular Transport, Small Molecule Biochemistry	Exchange of L-glutamic acid	2.67E-03	2
Amino Acid Metabolism, Molecular Transport, Small Molecule Biochemistry	Exchange of L-aspartic acid	2.67E-03	2
Cell Morphology, Cellular Movement	Cell spreading of prostate cancer cell lines	2.61E-04	3
Embryonic Development, Tissue Morphology	Structural integrity of Reichert's membrane	9.09E-04	2
Cell Cycle	Delay in initiation of metaphase/anaphase transition of cervical cancer cell lines	2.67E-03	2
Cell Cycle	Arrest in cell cycle progression of neuroblastoma cell lines	2.67E-03	2
Embryonic Development, Organismal Development, Skeletal and Muscular System Development and Function, Tissue Development	Delay in ossification of embryonic tissue	9.09E-04	2
Carbohydrate Metabolism, Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Secretion of lysophosphatidic acid	2.67E-03	2
Cellular Movement, Hematological System Development and Function	Leukostasis	2.61E-04	3
Digestive System Development and Function, Hepatic System Development and Function, Organ Morphology, Organismal Development	Mass of liver	4.72E-04	8
Cell Morphology, Cell-To-Cell Signaling and Interaction, Cellular Assembly and Organization, Nervous System Development and Function, Tissue Morphology	Structure of synapse	9.09E-04	2
Cell Morphology, Cellular Movement	Cell spreading of lung cell lines	2.67E-03	2

Cell-To-Cell Signaling and Interaction, Cellular Growth and Proliferation, Hematological System Development and Function, Nervous System Development and Function	Stimulation of microglia	2.67E-03	2
Cell-To-Cell Signaling and Interaction, Skeletal and Muscular System Development and Function	Binding of smooth muscle cells	5.67E-04	6
Cellular Function and Maintenance, Cellular Movement, Hematological System Development and Function, Immune Cell Trafficking, Lymphoid Tissue Structure and Development	Stasis of leukocytes	5.10E-04	3
Cell Death and Survival	Antiapoptosis of stomach cancer cell lines	2.67E-03	2
Cell-To-Cell Signaling and Interaction, Nervous System Development and Function	Synaptic transmission of muscle	2.67E-03	2
Carbohydrate Metabolism, Molecular Transport, Small Molecule Biochemistry	Cycling of D-glucose	9.09E-04	2
Cell Morphology, Connective Tissue Development and Function	Mineralization of fibroblast cell lines	1.37E-03	3
Lipid Metabolism, Molecular Transport, Small Molecule Biochemistry	Quantity of ganglioside GM3	1.43E-03	4
Connective Tissue Development and Function, Tissue Development	Formation of adipose tissue	2.67E-03	2
Cell Morphology, Cellular Movement	Cell spreading of bone cancer cell lines	2.00E-03	3
Cell Cycle, Cellular Assembly and Organization, DNA Replication, Recombination, and Repair	Opening of chromatin	2.67E-03	2
Nervous System Development and Function, Organ Morphology, Organismal Development	Volume of brain	3.26E-03	4
Cell Morphology, Cellular Movement	Cell spreading of keratinocyte cancer cell lines	2.67E-03	2
Carbohydrate Metabolism, Molecular Transport, Nucleic Acid Metabolism, Small Molecule Biochemistry	Quantity of UDP-D-glucose	2.67E-03	2
Tissue Morphology	Structural integrity of basement membrane	2.67E-03	2

a) The p-value: statistical overlap of differentially expressed gene list and gene set

b) Z-score: $z > 1.96$ to be significantly activated or increased, and those with $z < -1.96$ to be significantly inhibited