
MyGene.info Documentation

Release 3.0

Chunlei Wu

Apr 23, 2019

1	Introduction	1
2	What's new in v3 API	3
3	Quick start	5
3.1	Gene query service	5
3.1.1	URL	5
3.1.2	Examples	5
3.1.3	To learn more	5
3.2	Gene annotation service	6
3.2.1	URL	6
3.2.2	Examples	6
3.2.3	To learn more	6
4	Documentation	7
4.1	Migration from v2 API	7
4.1.1	URL change	7
4.1.2	Returned Objects	7
4.2	Gene annotation data	12
4.2.1	Data sources	12
4.2.2	Gene object	12
4.2.3	_id field	13
4.2.4	_score field	13
4.2.5	Species	13
4.2.6	Genome assemblies	13
4.2.7	Available fields	14
4.3	Data release notes	14
4.3.1	MyGene Releases	14
4.4	Gene query service	14
4.4.1	Service endpoint	14
4.4.2	GET request	14
4.4.3	Batch queries via POST	22
4.5	Gene annotation service	25
4.5.1	Service endpoint	25
4.5.2	GET request	25
4.5.3	Batch queries via POST	83
4.6	Server response	85

4.6.1	Status code <i>200</i>	85
4.6.2	Status code <i>400</i>	85
4.6.3	Status code <i>404</i>	86
4.6.4	Status code <i>5xx</i>	86
4.7	Usage and Demo	86
4.7.1	Call from web applications	86
4.7.2	Demo Applications	87
4.7.3	Autocomplete widget for gene query	88
4.8	Third-party packages	90
4.8.1	MyGene python module	90
4.8.2	MyGene R package	91
4.8.3	MyGene autocomplete widget	91
4.8.4	Another MyGene Python wrapper	91
4.9	Terms of Use	92
5	How to cite	95
6	FAQ	97
7	Related links	99
8	Contact us	101

CHAPTER 1

Introduction



MyGene.info provides simple-to-use REST web services to query/retrieve gene annotation data. It's designed with **simplicity** and **performance** emphasized. A typical use case is to use it to power a web application which requires querying genes and obtaining common gene annotations. For example, MyGene.info services are used to power BioGPS.

CHAPTER 2

What's new in v3 API

- Refseq accession number now contains version
- “ensembl”, “refseq” and “accession” contains associations between RNA and protein
- Better mapping between Ensembl and Entrez gene IDs
- JSON structure slightly changed
- and more bugfixes

You can read more details about this version on our [blog](#)

[Migration guide from v2 to v3 API](#)

Still want to stick with v2 API for a while? It's still there: [v2 API](#), but annotation data there won't be updated any more.

MyGene.info provides two simple web services: one for gene queries and the other for gene annotation retrieval. Both return results in [JSON](#) format.

3.1 Gene query service

3.1.1 URL

```
http://mygene.info/v3/query
```

3.1.2 Examples

```
http://mygene.info/v3/query?q=cdk2
http://mygene.info/v3/query?q=cdk2&species=human
http://mygene.info/v3/query?q=cdk?
http://mygene.info/v3/query?q=IL*
http://mygene.info/v3/query?q=entrezgene:1017
http://mygene.info/v3/query?q=ensemblgene:ENSG00000123374
http://mygene.info/v3/query?q=cdk2&fields=symbol,refseq
```

Hint: View nicely formatted JSON result in your browser with this handy add-on: [JSON formater](#) for Chrome or [JSONView](#) for Firefox.

3.1.3 To learn more

- You can read the full description of our query syntax [here](#).
- Try it live on [interactive API page](#).

- Play with our [demo applications](#).
- Batch queries? Yes, you can. do it with a [POST request](#).

3.2 Gene annotation service

3.2.1 URL

```
http://mygene.info/v3/gene/<geneid>
```

3.2.2 Examples

```
http://mygene.info/v3/gene/1017  
http://mygene.info/v3/gene/ENSG00000123374  
http://mygene.info/v3/gene/1017?fields=name,symbol,summary
```

“<geneid>” can be any of valid Entrez or Ensembl Gene ids. A retired Entrez Gene id works too if it is replaced by a new one.

3.2.3 To learn more

- You can read [the full description of our query syntax here](#).
- Try it live on [interactive API page](#).
- Play with our [demo applications](#).
- Yes, batch queries via [POST request](#) as well.

4.1 Migration from v2 API

Migrating from v2 API to v3 API is easy. Here's a summary of the changes. You may also want to read our [blog](#) for complementary information.

4.1.1 URL change

You will need to access v3 API using “/v3” prefix for service urls:

Gene query service endpoint

v2 `http://mygene.info/v2/query`

v3 `http://mygene.info/v3/query`

Gene annotation service endpoint

v2 `http://mygene.info/v2/gene`

v3 `http://mygene.info/v3/gene`

4.1.2 Returned Objects

There are several small changes in the returned data structure, as summarized here:

Accession number with version

“**refseq**” and “**accession**” fields now contain accession number including version. Data can be search with and without version. Version is available for “*genomic*”, “*rna*” and “*protein*” accession number keys.

Note: “*genomic*” field is returned but is not searchable

v2: http://mygene.info/v2/query?q=NM_052827&fields=refseq.rna

```
1 {
2   "hits": [
3     {
4       "_id": "1017",
5       "refseq": {
6         "rna": [
7           "NM_001290230",
8           "NM_001798",
9           "NM_052827",
10          "XM_011537732"
11        ]
12      }
13    }
14  ],
15  "max_score": 0.51962745,
16  "took": 3,
17  "total": 1
18 }
19 }
```

v3: http://mygene.info/v3/query?q=NM_052827&fields=refseq.rna

```
1 {
2   "hits": [
3     {
4       "_id": "1017",
5       "_score": 10.052136,
6       "refseq": {
7         "rna": [
8           "NM_001290230.1",
9           "NM_001798.4",
10          "NM_052827.3",
11          "XM_011537732.1"
12        ]
13      }
14    }
15  ],
16  "total": 1,
17  "took": 14,
18  "max_score": 10.052136
19 }
```

“translation” field for RNA-protein mapping

For “**ensembl**”, “**refseq**” and “**accession**” fields, a new sub-field name “*translation*” is now available. It gives the association between RNA and its protein product. v2 does not have this information in returned objects.

v3: http://mygene.info/v3/query?q=NM_052827&fields=refseq.translation,refseq.rna,refseq.protein

```

1 {
2   "max_score": 10.052136,
3   "total": 1,
4   "hits": [
5     {
6       "_id": "1017",
7       "_score": 10.052136,
8       "refseq": {
9         "protein": [
10          "NP_001277159.1",
11          "NP_001789.2",
12          "NP_439892.2",
13          "XP_011536034.1"
14        ],
15        "rna": [
16          "NM_001290230.1",
17          "NM_001798.4",
18          "NM_052827.3",
19          "XM_011537732.1"
20        ],
21        "translation": [
22          {
23            "protein": "XP_011536034.1",
24            "rna": "XM_011537732.1"
25          },
26          {
27            "protein": "NP_001789.2",
28            "rna": "NM_001798.4"
29          },
30          {
31            "protein": "NP_439892.2",
32            "rna": "NM_052827.3"
33          },
34          {
35            "protein": "NP_001277159.1",
36            "rna": "NM_001290230.1"
37          }
38        ]
39      }
40    ]
41  },
42  "took": 4
43 }

```

“exons” data structure modification

Warning: Backward-incompatible, data structure changed

“exons” field has two major modifications. It now contains a list of dictionary instead of a dictionary indexed by the accession number. This accession number is found within the dictionary under the key “*transcript*”. Finally, inner “exons” key has been rename to “*position*”.

v2: <http://mygene.info/v2/gene/1698?fields=exons>

```

1 {
2   "_id": "259236",
3   "exons": {
4     "NM_147196": {
5       "cdsstart": 46701487,
6       "cdsend": 46709688,
7       "txstart": 46701332,
8       "txend": 46710923,
9       "chr": "3",
10      "exons": [
11        [
12          46701332,
13          46701580
14        ],
15        [
16          46705789,
17          46705907
18        ],
19        [
20          46709125,
21          46709275
22        ],
23        [
24          46709578,
25          46710923
26        ]
27      ],
28      "strand": 1
29    }
30  }
31 }
32 }
33 }

```

v3: <http://mygene.info/v3/gene/1698?fields=exons>

```

1 {
2   "_id": "259236",
3   "_score": 21.732534,
4   "exons": [
5     {
6       "cdsend": 46709688,
7       "cdsstart": 46701487,
8       "chr": "3",
9       "position": [
10        [
11          46701332,
12          46701580
13        ],
14        [
15          46705789,
16          46705907
17        ],
18        [
19          46709125,
20          46709275
21        ],

```

(continues on next page)

(continued from previous page)

```

22     [
23         46709578,
24         46710923
25     ]
26 ],
27 "strand": 1,
28 "transcript": "NM_147196",
29 "txend": 46710923,
30 "txstart": 46701332
31 }
32 ]
33 }

```

“dotfield” notation default changed

Warning: May be backward-incompatible, default data structure changed (but can be restored with “dotfield” paramater setting)

By default, “dotfield” notation is now disabled for gene annotation endpoint in v3 (/gene). It’s enabled by default in v2. You will need to explicitely pass “dotfield=1” to your queries to have the same behavior as v2.

Note: “dotfield” notation is disabled by default for gene query endpoint (/gene) in both v2 and v2

v2: <http://mygene.info/v2/gene/1017?fields=refseq.rna>

```

1 {
2
3   "_id": "1017",
4   "refseq.rna": [
5     "NM_001290230",
6     "NM_001798",
7     "NM_052827",
8     "XM_011537732"
9   ]
10
11 }
12 }

```

v3: <http://mygene.info/v3/gene/1017?fields=refseq.rna>

```

1 {
2   "_id": "1017",
3   "_score": 21.731894,
4   "refseq": {
5     "rna": [
6       "NM_001290230.1",
7       "NM_001798.4",
8       "NM_052827.3",
9       "XM_011537732.1"
10    ]
11  }
12 }

```

Querying “reporter” data source

“reporter” data now has to be queried explicitly, prefixing the query term by “reporter:”

v3: <http://mygene.info/v3/query?q=reporter:2845421&fields=reporter>

4.2 Gene annotation data

4.2.1 Data sources

We currently obtain the gene annotation data from several public data resources and keep them up-to-date, so that you don’t have to do it:

Source	Update frequency	Notes
NCBI Entrez	weekly snapshot	
Ensembl	whenever a new release is available	Ensembl Pre! and EnsemblGenomes are not included at the moment
Uniprot	whenever a new release is available	
NetAffx	whenever a new release is available	For “reporter” field
PharmGKB	whenever a new release is available	
UCSC	whenever a new release is available	For “exons” field
CPDB	whenever a new release is available	For “pathway” field

The most updated data information can be accessed [here](#).

4.2.2 Gene object

Gene annotation data are both stored and returned as a gene object, which is essentially a collection of fields (attributes) and their values:

```
{
  "_id": "1017",
  "_score": 20.4676,
  "taxid": 9606,
  "symbol": "CDK2",
  "entrezgene": 1017,
  "name": "cyclin-dependent kinase 2",
  "genomic_pos": {
    "start": 55966769,
    "chr": "12",
    "end": 55972784,
    "strand": 1
  }
}
```

The example above omits most of available fields. For a full example, you can just check out a few gene examples: [CDK2](#), [ADA](#). Or, did you try our [interactive API page](#) yet?

4.2.3 `_id` field

Each individual gene object contains an “`_id`” field as the primary key. The value of the “`_id`” field is the NCBI gene ID (the same as “`entrezgene`” field, but as a string) if available for a gene object, otherwise, Ensembl gene ID is used (e.g. those Ensembl-only genes). Here is [an example](#). We recommend to use “`entrezgene`” field for the NCBI gene ID, and “`ensembl.gene`” field for Ensembl gene ID, instead of using “`_id`” field.

Note: Regardless how the value of the “`_id`” field looks like, either NCBI gene ID or Ensembl gene ID always works for our gene annotation service `/v3/gene/<geneid>`.

4.2.4 `_score` field

You will often see a “`_score`” field in the returned gene object, which is the internal score representing how well the query matches the returned gene object. It probably does not mean much in [gene annotation service](#) when only one gene object is returned. In [gene query service](#), by default, the returned gene hits are sorted by the scores in descending order.

4.2.5 Species

We support **ALL** species annotated by NCBI and Ensembl. All of our services allow you to pass a “`species`” parameter to limit the query results. “`species`” parameter accepts taxonomy ids as the input. You can look for the taxonomy ids for your favorite species from [NCBI Taxonomy](#).

For convenience, we allow you to pass these *common names* for commonly used species (e.g. “`species=human,mouse,rat`”):

Common name	Genus name	Taxonomy id
human	Homo sapiens	9606
mouse	Mus musculus	10090
rat	Rattus norvegicus	10116
fruitfly	Drosophila melanogaster	7227
nematode	Caenorhabditis elegans	6239
zebrafish	Danio rerio	7955
thale-cress	Arabidopsis thaliana	3702
frog	Xenopus tropicalis	8364
pig	Sus scrofa	9823

If needed, you can pass “`species=all`” to query against all available species, although, we recommend you to pass specific species you need for faster response.

4.2.6 Genome assemblies

Our [gene query service](#) supports [genome interval queries](#). We import genomic location data from Ensembl, so all species available there are supported. You can find the their reference genome assemblies information [here](#).

This table lists the genome assemblies for commonly-used species:

Common name	Genus name	Genome assembly
human	Homo sapiens	GRCh38 (hg38), also support hg19
mouse	Mus musculus	GRCm38 (mm10), also support mm9
rat	Rattus norvegicus	Rnor_6.0 (rn6)
fruitfly	Drosophila melanogaster	BDGP6 (dm6)
nematode	Caenorhabditis elegans	WBcel235 (ce11)
zebrafish	Danio rerio	GRCz10 (danRer10)
frog	Xenopus tropicalis	JGI_7.0 (xenTro7)
pig	Sus scrofa	Sscrofa10.2 (susScr3)

4.2.7 Available fields

The table below lists of all of the possible fields that could be in a gene object.

4.3 Data release notes

This page contains metadata about each MyGene.info data release. Click a link to see more.

4.3.1 MyGene Releases

4.4 Gene query service

This page describes the reference for MyGene.info gene query web service. It's also recommended to try it live on our [interactive API page](#).

4.4.1 Service endpoint

```
http://mygene.info/v3/query
```

4.4.2 GET request

Query parameters

q

Required, passing user query. The detailed query syntax for parameter “q” we explained *below*.

fields

Optional, can be a comma-separated fields to limit the fields returned from the matching gene hits. The supported field names can be found from any gene object (e.g. [gene 1017](#)). Note that it supports dot notation as well, e.g., you can pass “refseq.rna”. If “fields=all”, all available fields will be returned. Default: “symbol,name,taxid,entrezgene”.

species

Optional, can be used to limit the gene hits from given species. You can use “common names” for nine common species (human, mouse, rat, fruitfly, nematode, zebrafish, thale-cress, frog and pig). All other species, you can provide their taxonomy ids. See [more details here](#). Multiple species can be passed using comma as a separator. Passing “all” will query against all available species. Default: all.

size

Optional, the maximum number of matching gene hits to return (with a cap of 1000 at the moment). Default: 10.

from

Optional, the number of matching gene hits to skip, starting from 0. Default: 0

Hint: The combination of “**size**” and “**from**” parameters can be used to get paging for large query:

<code>q=cdk*&size=50</code>	first 50 hits
<code>q=cdk*&size=50&from=50</code>	the next 50 hits

fetch_all

Optional, a boolean, which when TRUE, allows fast retrieval of all unsorted query hits. The return object contains a `_scroll_id` field, which when passed as a parameter to the query endpoint, returns the next 1000 query results. Setting `fetch_all = TRUE` causes the results to be inherently unsorted, therefore the `sort` parameter is ignored. For more information see [examples using fetch_all here](#). Default: FALSE.

scroll_id

Optional, a string containing the `_scroll_id` returned from a query request with `fetch_all = TRUE`. Supplying a valid `scroll_id` will return the next 1000 unordered results. If the next results are not obtained within 1 minute of the previous set of results, the `scroll_id` becomes stale, and a new one must be obtained with another query request with `fetch_all = TRUE`. All other parameters are ignored when the `scroll_id` parameter is supplied. For more information see [examples using scroll_id here](#).

sort

Optional, the comma-separated fields to sort on. Prefix with “-” for descending order, otherwise in ascending order. Default: sort by matching scores in descending order.

facets

Optional, a single field or comma-separated fields to return facets, for example, “`facets=taxid`”, “`facets=taxid,type_of_gene`”. See [examples of faceted queries here](#).

facet_size

Optional, an integer ($1 \leq \text{facet_size} \leq 1000$) that specifies how many buckets to return in a faceted query.

species_facet_filter

Optional, relevant when faceting on species (i.e., “facets=taxid” are passed). It’s used to pass species filter without changing the scope of faceting, so that the returned facet counts won’t change. Either species name or taxonomy id can be used, just like “*species*” parameter above. See *examples of faceted queries here*.

entrezonly

Optional, when passed as “true” or “1”, the query returns only the hits with valid Entrez gene ids. Default: false.

ensemblonly

Optional, when passed as “true” or “1”, the query returns only the hits with valid Ensembl gene ids. Default: false.

callback

Optional, you can pass a “**callback**” parameter to make a JSONP call.

dotfield

Optional, can be used to control the format of the returned gene object. If “dotfield” is true, the returned data object is returned flattened (no nested objects) using dotfield notation for key names. Default: false.

filter

Alias for “fields” parameter.

limit

Alias for “size” parameter.

skip

Alias for “from” parameter.

email

Optional, if you are regular users of our services, we encourage you to provide us an email, so that we can better track the usage or follow up with you.

Query syntax

Examples of query parameter “q”:

Simple queries

search for everything:

q=cdk2	search for any fields
q=tumor suppressor	default as "AND" for all query terms
q="cyclin-dependent kinase"	search for the phrase

Fielded queries

```
q=entrezgene:1017
q=symbol:cdk2
q=refseq:NM_001798
```

Available fields

This table lists some commonly used fields can be used for “fielded queries”. [Check here](#) for the complete list of available fields.

Field	Description	Examples
entrezgene	Entrez gene id	q=entrezgene:1017
ensembl.gene	Ensembl gene id	q=ensembl.gene:ENSG00000123374
symbol	official gene symbol	q=symbol:cdk2
name	gene name	q=name:cyclin-dependent
alias	gene alias	q=alias:p33
summary	gene summary text	q=summary:insulin
refseq	NCBI RefSeq id (both rna and proteins)	q=refseq:NM_001798 q=refseq:NP_439892
unigene	NCBI UniGene id	q=unigene:Hs.19192
homologene	NCBI HomoloGene id	q=homologene:74409
accession	NCBI GeneBank Accession number	q=accession:AA810989
ensembl.transcript	Ensembl transcript id	q=ensembl.transcript:ENST00000266970
ensembl.protein	Ensembl protein id	q=ensembl.protein:ENSP00000243067
uniprot	UniProt id	q=uniprot:P24941
ipi (deprecated!)	IPI id	q=ipi:IPI00031681
pdb	PDB id	q=pdb:1AQ1
prosite	Prosite id	q=prosite:PS50011
pfam	PFam id	q=pfam:PF00069

Continued on next page

Table 1 – continued from previous page

Field	Description	Examples
interpro	InterPro id	q=interpro:IPR008351
mim	OMIM id	q=mim:116953
pharmgkb	PharmGKB id	q=pharmgkb:PA101
reporter	Affymetrix probeset id	q=reporter:204252_at
reagent	GNF reagent id	q=reagent:GNF282834
go	Gene Ontology id	q=go:0000307
hgnc	HUGO Gene Nomenclature Committee	q=hgnc:1771
hprd	Human Protein Reference Database	q=hprd:00310
mgi	Mouse Genome Informatics	q=mgi:MGI:88339
rgd	Rat Genome Database	q=rgd:620620
flybase	A Database of Drosophila Genes & Genomes	q=flybase:FBgn0004107&species=fruitfly
wormbase	C elegans and related nematodes database	q=wormbase:WBGene00057218&species=31234
zfin	Zebrafish Information Network	q=zfin:ZDB-GENE-980526-104&species=zebrafish
tair	Arabidopsis Information Resource	q=tair:AT3G48750&species=thalecress
xenbase	Xenopus laevis and Xenopus tropicalis biology and genomics resource	q=xenbase:XB-GENE-1001990&species=frog
mirbase	database of published miRNA sequences and annotation	q=mirbase:MI0017267
retired	Retired Entrez gene id, including those with replaced gene ids.	q=retired:84999

Genome interval query

When we detect your query (“q” parameter) contains a genome interval pattern like this one:

```
chrX:151,073,054-151,383,976
```

we will do the genome interval query for you. Besides above interval string, you also need to specify “species” parameter (with the default as human). These are all accepted queries:

```
q=chrX:151073054-151383976&species:9606
q=chrX:151,073,054-151,383,976&species:human
```

Hint: As you can see above, the genomic locations can include commas in it.

See also:

Genome assembly information

Wildcard queries

Wildcard character “*” or “?” is supported in either simple queries or fielded queries:

q=CDK?	single character wildcard
q=symbol:CDK?	single character wildcard within "symbol" field
q=IL*R	multiple character wildcard

Note: Wildcard character can not be the first character. It will be ignored.

Boolean operators and grouping

You can use **AND/OR/NOT** boolean operators and grouping to form complicated queries:

q=tumor AND suppressor	AND operator
q=CDK2 OR BTK	OR operator
q="tumor suppressor" NOT receptor	NOT operator
q=(interleukin OR insulin) AND receptor	the use of parentheses

Returned object

A GET request like this:

```
http://mygene.info/v3/query?q=symbol:cdk2
```

should return hits as:

```
{
  "hits": [
    {
      "name": "cyclin-dependent kinase 2",
      "_score": 87.76775,
      "symbol": "CDK2",
      "taxid": 9606,
      "entrezgene": 1017,
      "_id": "1017"
    },
    {
      "name": "cyclin-dependent kinase 2",
      "_score": 79.480484,
      "symbol": "Cdk2",
      "taxid": 10090,
      "entrezgene": 12566,
      "_id": "12566"
    },
    {
      "name": "cyclin dependent kinase 2",
      "_score": 62.286797,
      "symbol": "Cdk2",

```

(continues on next page)

(continued from previous page)

```
"taxid": 10116,
"entrezgene": 362817,
"_id": "362817"
}
],
"total": 3,
"max_score": 87.76775,
"took": 4
}
```

Faceted queries

If you need to perform a faceted query, you can pass an optional “*facets*” parameter. For example, if you want to get the facets on species, you can pass “*facets=taxid*”:

A GET request like this:

```
http://mygene.info/v3/query?q=cdk2&size=1&facets=taxid
```

should return hits as:

```
{
  "hits": [
    {
      "entrezgene": 1017,
      "name": "cyclin-dependent kinase 2",
      "_score": 400.43347,
      "symbol": "CDK2",
      "_id": "1017",
      "taxid": 9606
    }
  ],
  "total": 26,
  "max_score": 400.43347,
  "took": 7,
  "facets": {
    "taxid": {
      "_type": "terms",
      "total": 26,
      "terms": [
        {
          "count": 14,
          "term": 9606
        },
        {
          "count": 7,
          "term": 10116
        },
        {
          "count": 5,
          "term": 10090
        }
      ]
    },
    "other": 0,
    "missing": 0
  }
}
```

(continues on next page)

(continued from previous page)

```

    }
  }
}

```

Another useful field to get facets on is “type_of_gene”:

```
http://mygene.info/v3/query?q=cdk2&size=1&facets=type_of_gene
```

It should return hits as:

```

{
  "hits": [
    {
      "entrezgene": 1017,
      "name": "cyclin-dependent kinase 2",
      "_score": 400.43347,
      "symbol": "CDK2",
      "_id": "1017",
      "taxid": 9606
    }
  ],
  "total": 26,
  "max_score": 400.43347,
  "took": 97,
  "facets": {
    "type_of_gene": {
      "_type": "terms",
      "total": 26,
      "terms": [
        {
          "count": 20,
          "term": "protein-coding"
        },
        {
          "count": 6,
          "term": "pseudo"
        }
      ]
    },
    "other": 0,
    "missing": 0
  }
}

```

If you need to, you can also pass multiple fields as comma-separated list:

```
http://mygene.info/v3/query?q=cdk2&size=1&facets=taxid,type_of_gene
```

Particularly relevant to species facets (i.e., “facets=taxid”), you can pass a “*species_facet_filter*” parameter to filter the returned hits on a given species, without changing the scope of the facets (i.e. facet counts will not change). This is useful when you need to get the subset of the hits for a given species after the initial faceted query on species.

You can see the different “hits” are returned in the following queries, while “facets” keeps the same:

```
http://mygene.info/v3/query?q=cdk?&size=1&facets=taxid&species_facet_filter=human
```

v.s.

```
http://mygene.info/v3/query?q=cdk?&size=1&facets=taxid&species_facet_filter=mouse
```

Scrolling queries

If you want to return ALL results of a very large query (>10,000 results), sometimes the paging method described *above* can take too long. In these cases, you can use a scrolling query. This is a two-step process that turns off database sorting to allow very fast retrieval of all query results. To begin a scrolling query, you first call the query endpoint as you normally would, but with an extra parameter **fetch_all** = TRUE. For example, a GET request to:

```
http://mygene.info/v3/query?q=brain&fetch_all=TRUE
```

Returns the following object:

```
{
  "_scroll_id":
  ↪ "cXVlcnlUaGVuRmV0Y2g7MTA7MjA1NjY1MzMwO19HM29rRkg2VFZ5S1c3cTJtYkI4RHc7MjA1NjY1MjY3O1M0V1VCa194UWdLY",
  ↪ ",
  "max_score": 13.958638,
  "took": 270,
  "total": 14571,
  "hits": [
    {
      "_id": "390259",
      "_score": 13.958638,
      "entrezgene": 390259,
      "name": "brain specific homeobox",
      "symbol": "BSX",
      "taxid": 9606
    },
    .
    .
    .
  ]
}
```

At this point, the first 1000 hits have been returned (of ~14,000 total), and a scroll has been set up for your query. To get the next batch of 1000 unordered results, simply execute a GET request to the following address, supplying the **_scroll_id** from the first step into the **scroll_id** parameter in the second step:

```
http://mygene.info/v3/query?scroll_id=
↪ id=cXVlcnlUaGVuRmV0Y2g7MTA7MjA1NjY1MzMwO19HM29rRkg2VFZ5S1c3cTJtYkI4RHc7MjA1NjY1MjY3O1M0V1VCa194UWdLY
```

Hint: Your scroll will remain active for 1 minute from the last time you requested results from it. If your scroll expires before you get the last batch of results, you must re-request the scroll_id by setting **fetch_all** = TRUE as in step 1.

4.4.3 Batch queries via POST

Although making simple GET requests above to our gene query service is sufficient in most of use cases, there are some cases you might find it's more efficient to make queries in a batch (e.g., retrieving gene annotation for multiple genes). Fortunately, you can also make batch queries via POST requests when you need:

```
URL: http://mygene.info/v3/query
HTTP method: POST
```

Query parameters

q

Required, multiple query terms separated by comma (also support “+” or white space), but no wildcard, e.g., ‘q=1017,1018’ or ‘q=CDK2+BTK’

scopes

Optional, specify one or more fields (separated by comma) as the search “scopes”, e.g., “scopes=entrezgene”, “scopes=entrezgene,ensemblgene”. The available “fields” can be passed to “scopes” parameter are *listed above*. Default: “scopes=entrezgene,ensemblgene,retired” (either Entrez or Ensembl gene ids).

species

Optional, can be used to limit the gene hits from given species. You can use “common names” for nine common species (human, mouse, rat, fruitfly, nematode, zebrafish, thale-cress, frog and pig). All other species, you can provide their taxonomy ids. See [more details here](#). Multiple species can be passed using comma as a separator. Default: all.

fields

Optional, can be a comma-separated fields to limit the fields returned from the matching gene hits. The supported field names can be found from any gene object (e.g. [gene 1017](#)). Note that it supports dot notation as well, e.g., you can pass “refseq.rna”. If “fields=all”, all available fields will be returned. Default: “symbol,name,taxid,entrezgene”.

dotfield

Optional, can be used to control the format of the returned fields when passed “fields” parameter contains dot notation, e.g. “fields=refseq.rna”. If “dotfield” is true, the returned data object contains a single “refseq.rna” field, otherwise, a single “refseq” field with a sub-field of “rna”. Default: false.

email

Optional, if you are regular users of our services, we encourage you to provide us an email, so that we can better track the usage or follow up with you.

Example code

Unlike GET requests, you can easily test them from browser, make a POST request is often done via a piece of code. Here is a sample python snippet:

```
import requests
headers = {'content-type': 'application/x-www-form-urlencoded'}
params = 'q=1017,1018&scopes=entrezgene&fields=name,symbol,taxid,entrezgene'
res = requests.post('http://mygene.info/v3/query', data=params, headers=headers)
```

Returned object

Returned result (the value of “res.text” variable above) from above example code should look like this:

```
[
  {
    '_id': '1017',
    '_score': 22.757837,
    'entrezgene': 1017,
    'name': 'cyclin dependent kinase 2',
    'query': '1017',
    'symbol': 'CDK2',
    'taxid': 9606
  },
  {
    '_id': '1018',
    '_score': 22.757782,
    'entrezgene': 1018,
    'name': 'cyclin dependent kinase 3',
    'query': '1018',
    'symbol': 'CDK3',
    'taxid': 9606
  }
]
```

Tip: “query” field in returned object indicates the matching query term.

Note: if no “fields” parameter is specified, all available fields will be returned

If a query term has no match, it will return with “**notfound**” field as “**true**”:

```
params = 'q=1017,dummy&scopes=entrezgene&fields=name,symbol,taxid,entrezgene'
res = requests.post('http://mygene.info/v3/query', data=params, headers=headers)
```

```
[
  {
    "name": "cyclin-dependent kinase 2",
    "symbol": "CDK2",
    "taxid": 9606,
    "entrezgene": 1017,
    "query": "1017",
    "_id": "1017"
  },
  {
    "query": "dummy",
    "notfound": true
  }
]
```

(continues on next page)

(continued from previous page)

```
}
]
```

If a query term has multiple matches, they will be included with the same “query” field:

```
params = 'q=tp53,1017&scopes=symbol,entrezgene&fields=name,symbol,taxid,entrezgene'
res = requests.post('http://mygene.info/v3/query', data=params, headers=headers)
```

```
[
  {
    "name": "tumor protein p53",
    "symbol": "TP53",
    "taxid": 9606,
    "entrezgene": 7157,
    "query": "tp53",
    "_id": "7157"
  },
  {
    "name": "tumor protein p53",
    "symbol": "Tp53",
    "taxid": 10116,
    "entrezgene": 24842,
    "query": "tp53",
    "_id": "24842"
  },
  {
    "name": "cyclin-dependent kinase 2",
    "symbol": "CDK2",
    "taxid": 9606,
    "entrezgene": 1017,
    "query": "1017",
    "_id": "1017"
  }
]
```

4.5 Gene annotation service

This page describes the reference for MyGene.info gene annotation web service. It’s also recommended to try it live on our [interactive API page](#).

4.5.1 Service endpoint

```
http://mygene.info/v3/gene
```

4.5.2 GET request

To obtain the gene annotation via our web service is as simple as calling this URL:

```
http://mygene.info/v3/gene/<geneid>
```

geneid above can be either Entrez gene id (“1017”) or Ensembl gene id (“ENSG00000123374”). By default, this will return the complete gene annotation object in JSON format. See [here](#) for an example and [here](#) for more details. If the input **geneid** is not valid, 404 (NOT FOUND) will be returned.

Hint: A retired Entrez gene id works too if it is replaced by a new one, e.g., [245794](#). But a “*discontinued*” gene id will not return any hit, e.g., [138](#).

Optionally, you can pass a “**fields**” parameter to return only the annotation you want (by filtering returned object fields):

```
http://mygene.info/v3/gene/1017?fields=name,symbol
```

“**fields**” accepts any attributes (a.k.a fields) available from the gene object. Multiple attributes should be separated by commas. If an attribute is not available for a specific gene object, it will be ignored. Note that the attribute names are case-sensitive.

Just like [gene query service](#), you can also pass a “**callback**” parameter to make a [JSONP](#) call.

Query parameters

fields

Optional, can be a comma-separated fields to limit the fields returned from the gene object. If “fields=all”, all available fields will be returned. Note that it supports dot notation as well, e.g., you can pass “refseq.rna”. Default: “fields=all”.

callback

Optional, you can pass a “**callback**” parameter to make a [JSONP](#) <<http://ajaxian.com/archives/jsonp-json-with-padding>> call.

filter

Alias for “fields” parameter.

dotfield

Optional, can be used to control the format of the returned fields when passed “fields” parameter contains dot notation, e.g. “fields=refseq.rna”. If “dotfield” is true, the returned data object contains a single “refseq.rna” field, otherwise, a single “refseq” field with a sub-field of “rna”. Default: false.

email

Optional, if you are regular users of our services, we encourage you to provide us an email, so that we can better track the usage or follow up with you.

Returned object

A GET request like this:

```
http://mygene.info/v3/gene/1017
```

should return a gene object below:

```
{
  "HGNC": "1771",
  "HPRD": "00310",
  "MIM": "116953",
  "Vega": "OTTHUMG00000170575",
  "_id": "1017",
  "_score": 21.731894,
  "accession": {
    "genomic": [
      "AC025162.48",
      "AC034102.32",
      "AF512553.1",
      "AJ223951.1",
      "AMYH02026556.1",
      "AMYH02026557.1",
      "CH471054.1",
      "KT584459.1",
      "NC_000012.12",
      "NC_018923.2",
      "NG_034014.1",
      "U50730.2"
    ],
    "protein": [
      "AAA35667.1",
      "AAH03065.1",
      "AAM34794.1",
      "AAP35467.1",
      "ABM84693.1",
      "ABM92215.1",
      "BAA32794.1",
      "BAF84630.1",
      "BAG56780.1",
      "CAA43807.1",
      "CAA43985.1",
      "CAL38014.1",
      "EAW96856.1",
      "EAW96857.1",
      "EAW96858.1",
      "EAW96859.1",
      "EAW96860.1",
      "NP_001277159.1",
      "NP_001789.2",
      "NP_439892.2",
      "P24941.2",
      "XP_011536034.1"
    ],
    "rna": [
      "AA789250.1",
      "AA810989.1",
      "AB012305.1",

```

(continues on next page)

(continued from previous page)

```
"AK291941.1",
"AK293246.1",
"AM393136.1",
"BC003065.2",
"BJ991087.1",
"BT006821.1",
"DA814453.1",
"DQ890598.2",
"DQ893767.2",
"M68520.1",
"NM_001290230.1",
"NM_001798.4",
"NM_052827.3",
"X61622.1",
"X62071.1",
"XM_011537732.1"
],
"translation": [
  {
    "protein": "BAA32794.1",
    "rna": "AB012305.1"
  },
  {
    "protein": "XP_011536034.1",
    "rna": "XM_011537732.1"
  },
  {
    "protein": "ABM92215.1",
    "rna": "DQ890598.2"
  },
  {
    "protein": "NP_439892.2",
    "rna": "NM_052827.3"
  },
  {
    "protein": "AAA35667.1",
    "rna": "M68520.1"
  },
  {
    "protein": "BAG56780.1",
    "rna": "AK293246.1"
  },
  {
    "protein": "BAF84630.1",
    "rna": "AK291941.1"
  },
  {
    "protein": "AAP35467.1",
    "rna": "BT006821.1"
  },
  {
    "protein": "CAA43807.1",
    "rna": "X61622.1"
  },
  {
    "protein": "CAL38014.1",
    "rna": "AM393136.1"
  }
]
```

(continues on next page)

(continued from previous page)

```

    },
    {
      "protein": "CAA43985.1",
      "rna": "X62071.1"
    },
    {
      "protein": "AAH03065.1",
      "rna": "BC003065.2"
    },
    {
      "protein": "NP_001789.2",
      "rna": "NM_001798.4"
    },
    {
      "protein": "NP_001277159.1",
      "rna": "NM_001290230.1"
    },
    {
      "protein": "ABM84693.1",
      "rna": "DQ893767.2"
    }
  ]
},
"alias": [
  "CDKN2",
  "p33 (CDK2)"
],
"ec": "2.7.11.22",
"ensembl": {
  "gene": "ENSG00000123374",
  "protein": [
    "ENSP00000243067",
    "ENSP00000266970",
    "ENSP00000393605",
    "ENSP00000450983",
    "ENSP00000452138",
    "ENSP00000452514"
  ],
  "transcript": [
    "ENST00000266970",
    "ENST00000354056",
    "ENST00000440311",
    "ENST00000553376",
    "ENST00000554545",
    "ENST00000554619",
    "ENST00000555357",
    "ENST00000555408",
    "ENST00000556146",
    "ENST00000556276",
    "ENST00000556464",
    "ENST00000556656"
  ],
  "translation": [
    {
      "protein": "ENSP00000266970",
      "rna": "ENST00000266970"
    }
  ],

```

(continues on next page)

(continued from previous page)

```
{
  "protein": "ENSP00000450983",
  "rna": "ENST00000555408"
},
{
  "protein": "ENSP00000452514",
  "rna": "ENST00000553376"
},
{
  "protein": "ENSP00000393605",
  "rna": "ENST00000440311"
},
{
  "protein": "ENSP00000452138",
  "rna": "ENST00000555357"
},
{
  "protein": "ENSP00000243067",
  "rna": "ENST00000354056"
}
]
},
"entrezgene": 1017,
"exons": [
  {
    "cdsend": 55971625,
    "cdsstart": 55967008,
    "chr": "12",
    "position": [
      [
        55966768,
        55967124
      ],
      [
        55968048,
        55968169
      ],
      [
        55968777,
        55968948
      ],
      [
        55971043,
        55971247
      ],
      [
        55971520,
        55972789
      ]
    ],
    "strand": 1,
    "transcript": "NM_001290230",
    "txend": 55972789,
    "txstart": 55966768
  },
  {
    "cdsend": 55971625,
```

(continues on next page)

(continued from previous page)

```

"cdsstart": 55967008,
"chr": "12",
"position": [
  [
    55966768,
    55967124
  ],
  [
    55967856,
    55967934
  ],
  [
    55968048,
    55968169
  ],
  [
    55968777,
    55968948
  ],
  [
    55969474,
    55969576
  ],
  [
    55971043,
    55971247
  ],
  [
    55971520,
    55972789
  ]
],
"strand": 1,
"transcript": "NM_001798",
"txend": 55972789,
"txstart": 55966768
},
{
"cdsend": 55971625,
"cdsstart": 55967008,
"chr": "12",
"position": [
  [
    55966768,
    55967124
  ],
  [
    55967856,
    55967934
  ],
  [
    55968048,
    55968169
  ],
  [
    55968777,
    55968948

```

(continues on next page)

(continued from previous page)

```
    ],
    [
      55971043,
      55971247
    ],
    [
      55971520,
      55972789
    ]
  ],
  "strand": 1,
  "transcript": "NM_052827",
  "txend": 55972789,
  "txstart": 55966768
}
],
"exons_hg19": [
  {
    "cdsend": 56365409,
    "cdsstart": 56360792,
    "chr": "12",
    "position": [
      [
        56360552,
        56360908
      ],
      [
        56361832,
        56361953
      ],
      [
        56362561,
        56362732
      ],
      [
        56364827,
        56365031
      ],
      [
        56365304,
        56366573
      ]
    ],
    "strand": 1,
    "transcript": "NM_001290230",
    "txend": 56366573,
    "txstart": 56360552
  },
  {
    "cdsend": 56365409,
    "cdsstart": 56360792,
    "chr": "12",
    "position": [
      [
        56360552,
        56360908
      ],
    ],

```

(continues on next page)

(continued from previous page)

```

    [
      56361640,
      56361718
    ],
    [
      56361832,
      56361953
    ],
    [
      56362561,
      56362732
    ],
    [
      56363258,
      56363360
    ],
    [
      56364827,
      56365031
    ],
    [
      56365304,
      56366573
    ]
  ],
  "strand": 1,
  "transcript": "NM_001798",
  "txend": 56366573,
  "txstart": 56360552
},
{
  "cdsend": 56365409,
  "cdsstart": 56360792,
  "chr": "12",
  "position": [
    [
      56360552,
      56360908
    ],
    [
      56361640,
      56361718
    ],
    [
      56361832,
      56361953
    ],
    [
      56362561,
      56362732
    ],
    [
      56364827,
      56365031
    ],
    [
      56365304,

```

(continues on next page)

(continued from previous page)

```

    56366573
  ]
  ],
  "strand": 1,
  "transcript": "NM_052827",
  "txend": 56366573,
  "txstart": 56360552
}
],
"generif": [
  {
    "pubmed": 11907280,
    "text": "Cyclin A/Cdk2 and cyclin E/cdk2 continuously shuttle between the_
↪nucleus and the cytoplasm"
  },
  {
    "pubmed": 12049628,
    "text": "results argue that TTK-associated CDK2 may function to maintain target-
↪specific phosphorylation of RNA Pol II that is essential for Tat transactivation of_
↪HIV-1 promoter"
  },
  {
    "pubmed": 12081504,
    "text": "Activation mechanism role of cyclin binding versus phosphorylation"
  },
  {
    "pubmed": 12114499,
    "text": "CDK2/cyclin E is required for Tat-dependent transcription in vitro."
  },
  {
    "pubmed": 12149264,
    "text": "CDK2 binding to cyclin E is required to drive cells from G(1) into S_
↪phase"
  },
  {
    "pubmed": 12531694,
    "text": "Interferon gamma reduces the activity of Cdk4 and Cdk2, inhibiting he_
↪G1 cell cycle in human hepatocellular carcinoma cells."
  },
  {
    "pubmed": 12676582,
    "text": "CDK2 is not required for sustained cell division."
  },
  {
    "pubmed": 12729791,
    "text": "Data suggest that the interaction between PKCeta and cyclin E is_
↪carefully regulated, and is correlated with the inactivated form of the cyclin E/
↪Cdk2 complex."
  },
  {
    "pubmed": 12732645,
    "text": "IRF1 represses CDK2 gene expression by interfering with SP1-dependent_
↪transcriptional activation."
  },
  {
    "pubmed": 12801928,
    "text": "role in regulating Cdc25A half life"
  }
]

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 12810668,
      "text": "TGF-beta 1 inhibition requires early G(1) induction and stabilization_
↳of p21 protein, which binds to & inhibits cyclin E-CDK2 and cyclin A-CDK2 kinase_
↳activity rather than direct modulation of cyclin or CDK protein levels as seen in_
↳other systems."
    },
    {
      "pubmed": 12857729,
      "text": "Cdk2 has a role in phosphorylation of the NF-Y transcription factor"
    },
    {
      "pubmed": 12912980,
      "text": "CDK2 has a role in the G2 DNA damage checkpoint"
    },
    {
      "pubmed": 12915577,
      "text": "Kaposi's sarcoma-associated herpesvirus K-bZIP physically associates_
↳with cyclin-CDK2 and downmodulates its kinase activity."
    },
    {
      "pubmed": 12947099,
      "text": "it is evident that B-Myb protein may promote cell proliferation by a_
↳non-transcriptional mechanism that involves release of active cyclin/cyclin_
↳dependent kinase 2 from cyclin-dependent inhibitor 1C p57(KIP2) "
    },
    {
      "pubmed": 12954644,
      "text": "Inhibition of Cdk2 by 1,25-(OH)2D3 may thus involve two mechanisms: 1)_
↳reduced nuclear Cdk2 available for cyclin binding and activation and 2) impairment_
↳of cyclin E-Cdk2-dependent p27 degradation through cytoplasmic mislocalization of_
↳Cdk2."
    },
    {
      "pubmed": 14506259,
      "text": "kinetic insight into the basis for selecting suboptimal specificity_
↳determinants for the phosphorylation of cellular substrates"
    },
    {
      "pubmed": 14536078,
      "text": "multisite phosphorylation by Cdk2 and GSK3 controls cyclin E_
↳degradation"
    },
    {
      "pubmed": 14550307,
      "text": "CDK2 binds to SU9516 at Leu83 and Glu81"
    },
    {
      "pubmed": 14551212,
      "text": "CDK2 activation process through phosphorylation is examined using 2D_
↳PAGE"
    },
    {
      "pubmed": 14562046,
      "text": "Epstein-Barr virus can inhibit genotoxin-induced G1 arrest downstream_
↳of p53 by preventing the inactivation of CDK2"
    }
  ],
  "page": 2
}

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 14612403,
      "text": "p220 is an essential downstream component of the cyclin E/Cdk2_
↳signaling pathway and functions to coordinate multiple elements of the G1/S_
↳transition."
    },
    {
      "pubmed": 14645251,
      "text": "CDK2-cyclin E, without prior CDK4-cyclin D activity, can phosphorylate_
↳and inactivate pRb, activate E2F, and induce DNA synthesis."
    },
    {
      "pubmed": 14646596,
      "text": "significant difference in their biochemical properties between CDK4/
↳cyclin D1 and CDK2/cyclin A affecting regulation of cellular RB function"
    },
    {
      "pubmed": 14694185,
      "text": "cyclin-dependent kinase (CDK)2, -4, and -6 were down-regulated from_
↳the myelocytes/metamyelocytes stages and onward"
    },
    {
      "pubmed": 14701826,
      "text": "CDK2 complexes have roles in G(1)/S deregulation and tumor progression"
    },
    {
      "pubmed": 14985333,
      "text": "CDK2 regulates beta-catenin phosphorylation/ degradation"
    },
    {
      "pubmed": 15004027,
      "text": "Cdk2 and Cdk4 phosphorylate human Cdt1 and induce its degradation"
    },
    {
      "pubmed": 15024385,
      "text": "Binding to Cdk2-cyclin A is accompanied by p27 folding, and kinetic_
↳data suggest a sequential mechanism that is initiated by binding to cyclin A"
    },
    {
      "pubmed": 15063782,
      "text": "We also found that cyclin A/CDK2 phosphorylates Axin, thereby_
↳enhancing its association with beta-catenin."
    },
    {
      "pubmed": 15159402,
      "text": "study provides evidence that the cyclin A1-cyclin dependent kinase 2_
↳complex plays a role in several signaling pathways important for cell cycle control_
↳and meiosis"
    },
    {
      "pubmed": 15178429,
      "text": "interacts with dephosphorylated NIRF"
    },
    {
      "pubmed": 15199159,
      "text": "cyclin A-cdk2 plays an ancillary noncatalytic role in the_
↳ubiquitination of p27(KIP1) by the SCF(skp2) complex"
    }
  ]
}

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 15226429,
      "text": "Results identify an important role for CDK2 in the maintenance of
↪genomic stability, acting via an ATM- and ATR-dependent pathway."
    },
    {
      "pubmed": 15309028,
      "text": "after CDK4/6 inactivation, the fate of pancreatic tumor cells depends
↪on the ability to modulate CDK2 activity"
    },
    {
      "pubmed": 15355984,
      "text": "Data suggest that cyclin D1-Cdk2 complexes mediate some of the
↪transforming effects of cyclin D1 and demonstrate that the cyclin D1-Cdk2 fusion
↪protein is a useful model to investigate the biological functions of cyclin D1-Cdk2
↪complexes."
    },
    {
      "pubmed": 15456866,
      "text": "These findings establish a novel function for cyclin A1 and CDK2 in
↪DNA double strand break repair following radiation damage."
    },
    {
      "pubmed": 15572662,
      "text": "Phosphorylation of progesterone receptor serine 400 mediates ligand-
↪independent transcriptional activity in response to activation of CDK2."
    },
    {
      "pubmed": 15601848,
      "text": "cyclin A/Cdk2 has a role as a progesterone receptor coactivator"
    },
    {
      "pubmed": 15607961,
      "text": "CDK2 depletion suppressed growth and cell cycle progression in
↪melanoma and may be a suitable drug target in melanoma."
    },
    {
      "pubmed": 15611077,
      "text": "Inhibition of CDK2 kinase by indole-3-carbinol is accompanied by
↪selective alterations in cyclin E composition."
    },
    {
      "pubmed": 15632290,
      "text": "molecular dynamics study on the complex CDK2 with the peptide
↪substrate HHASPRK"
    },
    {
      "pubmed": 15649889,
      "text": "Results demonstrate that a peptide derived from the alpha5 helix of
↪cyclin A significantly inhibits kinase activity of complexes harboring CDK2, and
↪forms stable complexes with CDK2-cyclin A."
    },
    {
      "pubmed": 15660127,
      "text": "crystal structure of phospho-CDK2 in complex with a truncated cyclin
↪E1 (residues 81-363) at 2.25 A resolution"
    }
  ],

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 15665273,
      "text": "CDK2-BRCA1-Nucleophosmin pathway coordinately functions in cell growth_
↪and tumor progression pathways."
    },
    {
      "pubmed": 15671017,
      "text": "HTm4 binding to KAP.Cdk2.cyclin A complex enhances the phosphatase_
↪activity of KAP, dissociates cyclin A, and facilitates KAP dephosphorylation of Cdk2
↪"
    },
    {
      "pubmed": 15695825,
      "text": "Results present a comprehensive description of the dynamic behavior of_
↪cyclin-dependent kinase 2 in complex with cyclin A."
    },
    {
      "pubmed": 15707957,
      "text": "Puralpha has been shown to colocalize with cyclin A/Cdk2 and to_
↪coimmunoprecipitate with cyclin A during S-phase and we show that this interaction_
↪is mediated by a specific affinity of Puralpha for Cdk2."
    },
    {
      "pubmed": 15890360,
      "text": "Rapid binding of p27 domain 1 to cyclin A tethers the inhibitor to the_
↪binary Cdk2/cyclin A complex"
    },
    {
      "pubmed": 15922732,
      "text": "CDK2 translational down-regulation may be a key regulatory event in_
↪replicative senescence of endothelial cells."
    },
    {
      "pubmed": 15944161,
      "text": "origin recognition complex 2 has an unexpected role in CDK2 activation,
↪ a linkage that could be important for maintaining genomic stability"
    },
    {
      "pubmed": 15964852,
      "text": "Cdk2 destabilizes p21 via the cy2 cyclin-binding motif and p21_
↪phosphorylation"
    },
    {
      "pubmed": 16036217,
      "text": "Our results demonstrate that differential regulation of Cdc2 and Cdk2_
↪activity by different doses of doxorubicin may contribute to the induction of two_
↪modes of cell death in hepatoma cells, either apoptosis or cell death through_
↪mitotic catastrophe."
    },
    {
      "pubmed": 16082200,
      "text": "CINP is part of the Cdc7-dependent mechanism of origin firing and a_
↪functional and physical link between Cdk2 and Cdc7 complexes at the origins"
    },
    {
      "pubmed": 16082227,

```

(continues on next page)

(continued from previous page)

```

    "text": "CDK2 inhibition modifies the dynamics of chromatin-bound_
↪minichromosome maintenance complex and replication protein A"
  },
  {
    "pubmed": 16085226,
    "text": "results indicate that CDK2 participates in Tat-mediated HIV-1_
↪transcription and may serve as a potential therapeutic target"
  },
  {
    "pubmed": 16150942,
    "text": "Cdk2 inhibition decreases the efficiency of chemical induction of KSHV_
↪lytic transcripts ORF 50 and 26. Importantly, Cdk2 activity is also essential for_
↪replication in other human herpesviruses"
  },
  {
    "pubmed": 16258277,
    "text": "A new concept indicates in this review that both Cdk2 and/or Cdc2 can_
↪drive cells through G1/S phase in parallel."
  },
  {
    "pubmed": 16262700,
    "text": "Cdk2 dependent phosphorylation(s) cannot be a critical trigger of_
↪replicon initiation in response to reoxygenation after several hours of hypoxia, at_
↪least in the T24 cells studied"
  },
  {
    "pubmed": 16343435,
    "text": "We propose that during TNFalpha-induced apoptosis, PKCdelta-mediated_
↪phosphorylation of p21(WAF1/CIP1) at (146)Ser attenuates the Cdk2 binding of_
↪p21(WAF1/CIP1) and thereby upregulates Cdk2 activity."
  },
  {
    "pubmed": 16407256,
    "text": "molecular analysis of the CDK5/p25 and CDK2/cyclin A systems"
  },
  {
    "pubmed": 16504183,
    "text": "Cyclin-dependent kinases regulate the transcriptional activity of_
↪FOXM1c; a combination of three phosphorylation sites mediates the Cyclin E and_
↪Cyclin A/CDK2 effects."
  },
  {
    "pubmed": 16540140,
    "text": "Here, we show that human papillomavirus type 16 16E1--E4 is also able_
↪to associate with cyclin A and Cdk2 during the G2 phase of the cell cycle."
  },
  {
    "pubmed": 16575928,
    "text": "The interaction between roscovitine and cyclin-dependent kinase 2_
↪(cdk2) was investigated by performing correlated ab initio quantum-chemical_
↪calculations."
  },
  {
    "pubmed": 16707497,
    "text": "the phospho-CDK2/cyclin A recruitment site has a role in substrate_
↪recognition"
  },
  },

```

(continues on next page)

(continued from previous page)

```

{
  "pubmed": 16762841,
  "text": "Phosphorylation of the linker histone H1 by CDK regulates its binding_
↪to HP1alpha"
},
{
  "pubmed": 16765349,
  "text": "suggest a novel retinoic acid (RA)-signaling, by which RA-induced p21_
↪induction and complex formation with cyclin E/CDK2 diverts CDK2 function from_
↪normally driving proliferation to alternatively promoting apoptosis"
},
{
  "pubmed": 16824683,
  "text": "Membrane depolarization may stimulate cellular proliferation by_
↪augmenting the expression of cyclin E leading to increases in Cdk2 activity and RB_
↪phosphorylation in a neuroblastoma cell line."
},
{
  "pubmed": 16912045,
  "text": "the Chk1-mediated S-phase checkpoint targets initiation factor Cdc45_
↪via a Cdc25A/Cdk2-independent mechanism"
},
{
  "pubmed": 16912201,
  "text": "Breast cancer cells lacking cancer predisposition genes BRCA1 are more_
↪sensitive to CDK2 inhibitors."
},
{
  "pubmed": 17001081,
  "text": "analysis of the NBI1-binding site on cyclin A which inhibits the_
↪catalytic activity of the complex cyclin-dependent kinase 2-cyclin A"
},
{
  "pubmed": 17013093,
  "text": "progression of melanoma is associated with changes in CDK-2 expression_
↪level"
},
{
  "pubmed": 17038621,
  "text": "functional interaction between CDK2 and FOXO1 provides a mechanism_
↪that regulates apoptotic cell death after DNA strand breakage"
},
{
  "pubmed": 17095507,
  "text": "Kinetic and crystallographic analyses of CDK2-cyclin A complexes_
↪reveal that this inhibitory mechanism operates through steric blockade of peptide_
↪substrate binding."
},
{
  "pubmed": 17207508,
  "text": "Review highlights an alternative role for CDK2 in the regulation of_
↪progesterone receptor signaling."
},
{
  "pubmed": 17293600,
  "text": "TopBP1 necessary for the G(1)/S transition: one for activating cyclin_
↪E/CDK2 kinase and the other for loading replication components onto chromatin to_
↪initiate DNA synthesis."
}

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 17361108,
      "text": "Our results demonstrate that CDK2 is capable of autophosphorylation at_
↪Thr160."
    },
    {
      "pubmed": 17371838,
      "text": "results argue that Mdm2 is needed for full inhibition of Cdk2 activity_
↪by p21, thereby positively contributing to p53-dependent cell cycle arrest"
    },
    {
      "pubmed": 17386261,
      "text": "Both Cdk1 and -2 require cyclin binding and T loop phosphorylation for_
↪full activity."
    },
    {
      "pubmed": 17409409,
      "text": "Observational study of gene-disease association. (HuGE Navigator)"
    },
    {
      "pubmed": 17495531,
      "text": "The structure of phospho-CDK2/cyclin B is reported. pCDK2/cyclin B is_
↪less discriminatory in substrate recognition than CDK2/cyclin A & has properties of_
↪both an S-phase & an M-phase kinase. CDK2/cyclin B is effective against S phase_
↪substrates."
    },
    {
      "pubmed": 17638878,
      "text": "ATRIP is a CDK2 substrate, and CDK2-dependent phosphorylation of S224_
↪regulates the ability of ATR-ATRIP to promote cell cycle arrest in response to DNA_
↪damage"
    },
    {
      "pubmed": 17713927,
      "text": "Phosphorylation on a conserved Thr14 can inhibit activities of both_
↪the kinases, but phosphorylating another conserved Tyr15, however, can lead to_
↪totally opposite inhibition and stimulation consequences in CDK2 and CDK5."
    },
    {
      "pubmed": 18042686,
      "text": "The conserved rigid regions are important for nucleotide binding,_
↪catalysis, and substrate recognition; most flexible regions correlate with those_
↪where large conformational changes occur during CDK2 regulation processes."
    },
    {
      "pubmed": 18156799,
      "text": "cdk2 activity is necessary for the survival of human DLBCL."
    },
    {
      "pubmed": 18174243,
      "text": "Observational study of gene-disease association. (HuGE Navigator)"
    },
    {
      "pubmed": 18199752,
      "text": "major Cdk2-dependent multiple gene regulatory events are present in_
↪pemphigus vulgar"

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 18202766,
      "text": "serum starvation induces G1 arrest through suppression of Skp2-
↳dependent CDK2 activity and Skp2-independent CDK4 activity in human SK-OV-3 ovarian
↳cancer cells"
    },
    {
      "pubmed": 18208561,
      "text": "growth arrest by SmE directly correlates with the reduction of cyclin
↳E, CDK2, CDC25C and CDC2 expression, and up-regulation of p27Kip"
    },
    {
      "pubmed": 18236071,
      "text": "Findings strongly demonstrate that retinoblastoma (RB) and cyclin-
↳dependent kinase 2 (CDK2) on one side and cytokeratin 8 (CK8) and epidermal growth
↳factor receptor 2 (HER2) on the other may affect the clinical course of the disease
↳in 56% of patients."
    },
    {
      "pubmed": 18276582,
      "text": "Cyclin E and SV40 small T antigen cooperate to bypass quiescence and
↳contribute to transformation by activating CDK2 in human fibroblasts"
    },
    {
      "pubmed": 18281541,
      "text": "Observational study of gene-disease association. (HuGE Navigator)"
    },
    {
      "pubmed": 18345036,
      "text": "Bim-mediated apoptosis following actin damage due to deregulation of
↳Cdk2 and the cell cycle by the absence of functional p53."
    },
    {
      "pubmed": 18372919,
      "text": "G2 phase cyclin A/cdk2 controls the timing of entry into mitosis by
↳controlling the subsequent activation of cyclin B/cdk1, but also has an unexpected
↳role in coordinating the activation of cyclin B/cdk1 at the centrosome and in the
↳nucleus"
    },
    {
      "pubmed": 18400748,
      "text": "disruption of the spindle-assembly checkpoint does not directly
↳influence p53 activation, but the shortening of the mitotic arrest allows cyclin E-
↳CDK2 to be activated before the accumulation of p21(CIP1/WAF1)."
    },
    {
      "pubmed": 18408738,
      "text": "Results suggest that GSK-3 regulates nuclear p27 Kip1 expression
↳through downregulation of Skp2 expression and regulates p27 Kip1 assembly with CDK2,
↳ playing a critical role in the G0/G1 arrest associated with intestinal cell
↳differentiation."
    },
    {
      "pubmed": 18470542,
      "text": "The structures of fully active cyclin-dependent kinase-2
↳(CDK2) complexed with ATP and peptide substrate, CDK2 after the catalytic reaction,
↳and CDK2 inhibited by phosphorylation at Thr14/Tyr15 were studied using molecular
↳dynamics simulations."
    }
  ],
  "text": "The structures of fully active cyclin-dependent kinase-2
↳(CDK2) complexed with ATP and peptide substrate, CDK2 after the catalytic reaction,
↳and CDK2 inhibited by phosphorylation at Thr14/Tyr15 were studied using molecular
↳dynamics simulations."
}

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 18507837,
      "text": "Observational study of gene-disease association. (HuGE Navigator)"
    },
    {
      "pubmed": 18617527,
      "text": "Cdk2-associated complexes, by targeting SHP-1 for proteolysis,
↪counteract the ability of SHP-1 to block cell cycle progression of intestinal
↪epithelial cells"
    },
    {
      "pubmed": 18635963,
      "text": "Cyclin A-CDK activity during G(1) would result in an inhibition of
↪progression into the S phase."
    },
    {
      "pubmed": 18667424,
      "text": "the cyclin A-CDK2 complex may be a potential effector of NFATs,
↪specifically NFATc1, in mediating SMC multiplication leading to neointima formation.
↪"
    },
    {
      "pubmed": 18784074,
      "text": "Cdk2 negatively regulates the activity of hPXR, and suggest an
↪important role for Cdk2 in regulating hPXR activity and CYP3A4 expression in
↪hepatocytes passing through the cell cycle"
    },
    {
      "pubmed": 18806832,
      "text": "This suggests an important role for CDK2 in cell cycle regulation in
↪hESCs that are likely to bear significant impacts on the maintenance of their
↪pluripotent phenotype."
    },
    {
      "pubmed": 18941885,
      "text": "Observational study of gene-disease association. (HuGE Navigator)"
    },
    {
      "pubmed": 19061641,
      "text": "Cyclin A assembles with Cdk1 only after complex formation with Cdk2
↪reaches a plateau during late S and G2 phases."
    },
    {
      "pubmed": 19066288,
      "text": "These findings establish phosphorylation events by CDKs 1 and 2 as key
↪regulators of Discs Large 1 localisation and function."
    },
    {
      "pubmed": 19091404,
      "text": "Notch-1 may be mediated through regulating the expression of cell
↪cycle regulatory proteins cyclin D1, CDK2 and p21 and the activity of Akt signaling"
    },
    {
      "pubmed": 19101503,
      "text": "These results demonstrate that double phosphorylation of CDK2 peptides
↪increases the stoichiometry of metal ion binding, and hence may contribute to the
↪previously observed regulation of CDK2 activity by metal ions."
    }
  ]
}

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 19103742,
      "text": "the pathway of apoptin-induced apoptosis and show that it essentially
↳depends on abnormal phosphatidylinositol 3-kinase (PI3-kinase)/Akt activation,
↳resulting in the activation of the cyclin-dependent kinase CDK2"
    },
    {
      "pubmed": 19124506,
      "text": "Observational study of gene-disease association. (HuGE Navigator)"
    },
    {
      "pubmed": 19166026,
      "text": "Overexpression of CDK2 was strongly correlated with abnormal
↳proliferation in laryngeal squamous cell carcinoma."
    },
    {
      "pubmed": 19197163,
      "text": "Results show that human Cdk2 is a functional homolog for most of Ime2
↳functions."
    },
    {
      "pubmed": 19201832,
      "text": "disruption of Smad2 function by CDK2 phosphorylation acts as a
↳mechanism for TGF-beta resistance in multiple myeloma."
    },
    {
      "pubmed": 19258477,
      "text": "Observational study of gene-disease association. (HuGE Navigator)"
    },
    {
      "pubmed": 19258477,
      "text": "Strengthened signals in imputation-based analysis at CDK2 SNPs
↳rs2069391, rs2069414 and rs17528736 lend evidence to the role of cell cycle genes
↳in ovarian cancer etiology."
    },
    {
      "pubmed": 19321444,
      "text": "The combination of st and deregulated cyclin E result in cooperative
↳and coordinated activation of both an essential origin licensing factor, CDC6, and
↳an activity required for origin firing, CDK2, resulting in progression from
↳quiescence to S phase."
    },
    {
      "pubmed": 19440053,
      "text": "Co-depletion of Cdc6 and p53 in normal cells restored Cdk2 activation
↳and Rb phosphorylation, permitting them to enter S phase with a reduced rate of
↳replication."
    },
    {
      "pubmed": 19594747,
      "text": "Observational study of gene-disease association. (HuGE Navigator)"
    },
    {
      "pubmed": 19596857,
      "text": "resistance of oral squamous carcinoma to IFNgamma is not due to
↳deficiency in STAT1-dependent signaling but from a defect in the signaling
↳component that mediates IFNgamma-induced down-regulation of CcnA2 and CcnA1
↳expression"
    }
  ]
}

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 19609547,
      "text": "Four genes previously not examined in that respect in laryngeal_
↪carcinoma, occurred to be good markers of the neoplasm. They are: metal-proteinase_
↪ADAM12, cyclin-dependent kinase 2-CDK2, kinesin 14-KIF14, suppressor 1 of_
↪checkpoint-CHES1."
    },
    {
      "pubmed": 19631451,
      "text": "Data demonstrate that the novel anticancer mechanism of hinokitiol_
↪involves accumulation of p27, down-regulation of pRb, Skp2, and impairment of Cdk2_
↪function."
    },
    {
      "pubmed": 19703905,
      "text": "cyclin A/cdk2-dependent phosphorylation of APC affects astral_
↪microtubule attachment to the cortical surface in mitosis"
    },
    {
      "pubmed": 19706521,
      "text": "Results suggest that simple but robust rules encoded in the CDK2_
↪structure play a dominant role in predefining the mechanisms of ligand binding,_
↪which may be advantageously exploited in designing inhibitors."
    },
    {
      "pubmed": 19723060,
      "text": "Studies indicate that roscovitine arrests the cell cycle is direct_
↪inhibition of CDK1, a mitotic regulator, and CDK2, involved in G1/S transition."
    },
    {
      "pubmed": 19724860,
      "text": "Overexpression of Notch1 in laryngeal carcinoma cell line was coupled_
↪with the downregulation of cdk2"
    },
    {
      "pubmed": 19738611,
      "text": "Observational study of gene-disease association. (HuGE Navigator)"
    },
    {
      "pubmed": 19797611,
      "text": "results show that the expression of UGT1A1 and CYP2B6 is negatively_
↪regulated through a CDK2 signaling pathway linked to cell cycle progression in_
↪HepG2 and SW480 cells"
    },
    {
      "pubmed": 19822658,
      "text": "Results underscore the crucial role of cyclin A2-CDK2 in regulating_
↪the PLK1-SCF(beta-TrCP1)-EMI1-APC/C axis and CDC6 to trigger genome reduplication_
↪after the activity of CDK1 is suppressed."
    },
    {
      "pubmed": 19829063,
      "text": "Since CAC1 interacts with CDK2 and promotes the kinase activity of_
↪CDK2 protein, we propose that CAC1 is a novel cell cycle associated protein capable_
↪of promoting cell proliferation."
    },
  },

```

(continues on next page)

(continued from previous page)

```

{
  "pubmed": 19838212,
  "text": "Chk1 signalling causes centrosome amplification after ionizing_
↪radiation by upregulating Cdk2 activity through activating phosphorylation."
},
{
  "pubmed": 19838216,
  "text": "Data show that SHP-1 knockdown increases p27stability, decreases the_
↪CDK6 levels, inducing retinoblastoma protein hypophosphorylation, downregulation of_
↪cyclin E and thereby a decrease in the CDK2 activity."
},
{
  "pubmed": 19854217,
  "text": "expression upregulation is critical for TLR9-stimulated proliferation_
↪of kung cancer cells"
},
{
  "pubmed": 19858290,
  "text": "Export was also reduced by Cdk inhibition or cyclin A RNA interference,
↪ suggesting that cyclin A/Cdk complexes contribute to Wee1 export."
},
{
  "pubmed": 19885547,
  "text": "aberrant regulation of S100P in HCC might activate cyclin D1 and CDK_
↪expression and contribute to the mitogenic potential of tumor cells during_
↪Hepatocellular carcinoma carcinogenesis."
},
{
  "pubmed": 19960406,
  "text": "Cellular production of IGFBP-3 leads to G1 cell cycle arrest with_
↪inhibition of CDK2 and CDK4."
},
{
  "pubmed": 19966300,
  "text": "Data show that Myc repressed Ras-induced senescence, and that Cdk2_
↪interacted with Myc at promoters, where it affected Myc-dependent regulation of_
↪genes, including those of proteins known to control senescence."
},
{
  "pubmed": 20017906,
  "text": "FUS-DDIT3 and the normal DDIT3 bind CDK2."
},
{
  "pubmed": 20062077,
  "text": "Results directly show that the inhibition of Cdk1 activity and the_
↪persistence of Cdk2 activity in G2 cells induces endoreplication without mitosis."
},
{
  "pubmed": 20068231,
  "text": "Results show that most of the up-regulated sites phosphorylated by_
↪cyclin-dependent CDK1 or CDK2 were almost fully phosphorylated in mitotic cells."
},
{
  "pubmed": 20079829,
  "text": "the nitric oxide-mediated biphasic effect was dependent on Cdk2_
↪nitrosylation/activation and the loss of mitochondrial potential"
},
}

```

(continues on next page)

(continued from previous page)

```

{
  "pubmed": 20147522,
  "text": "central roles for CDK2 nuclear-cytoplasmic trafficking and cyclin E in
↳the mechanism of 1,25-(OH)(2)D(3)-mediated growth inhibition in prostate cancer
↳cells"
},
{
  "pubmed": 20195506,
  "text": "These findings demonstrate that Cdk2 maintains a balance of S-phase
↳regulatory proteins and thereby coordinates subsequent p53-independent G(2)/M
↳checkpoint activation."
},
{
  "pubmed": 20399812,
  "text": "Data describe the properties of a mutant form of Cdk2 identified
↳during large-scale sequencing of protein kinases from cancerous tissue."
},
{
  "pubmed": 20422243,
  "text": "Triticum aestivum-5B2 (( Ta ) 5B2) is suggested to be a wheat analogue
↳of human CDK2 enzyme."
},
{
  "pubmed": 20444741,
  "text": "Conclude that cisplatin likely activates both caspase-dependent and -
↳independent cell death, and Cdk2 is required for both pathways."
},
{
  "pubmed": 20465575,
  "text": "In addition to having a pivotal role in the up-regulation of IL-2 and
↳IL-2RA gene expression, IKK controls the expression of cyclin D3, cyclin E and CDK2,
↳and the stability SKP2 and its co-factor CKS1B, through mechanisms independent of
↳IL-2."
},
{
  "pubmed": 20508983,
  "text": "Observational study of gene-disease association. (HuGE Navigator)"
},
{
  "pubmed": 20512928,
  "text": "Hr and VDR interact via multiple protein-protein interfaces,
↳catalyzing histone demethylation to effect chromatin remodeling and repress the
↳transcription of VDR target genes that control the hair cycle."
},
{
  "pubmed": 20694007,
  "text": "protein phosphatase 1 competition with Cdk-cyclins for retinoblastoma
↳protein(Rb) binding is sufficient to retain Rb activity and block cell-cycle
↳advancement."
},
{
  "pubmed": 20711190,
  "text": "cyclin-dependent kinases (Cdks), especially Cdk1 and Cdk2, promote
↳interphase nuclear pore complex formation in human dividing cells."
},
{
  "pubmed": 20844047,

```

(continues on next page)

(continued from previous page)

```

    "text": "Nuclear export of HPV31 E1 is inhibited by Cdk2 phosphorylation at two_
↪serines residues, S92 and S106."
  },
  {
    "pubmed": 20935635,
    "text": "The results demonstrate that CDK2-mediated phosphorylation is a key_
↪mechanism governing EZH2 function and that there is a link between the cell-cycle_
↪machinery and epigenetic gene silencing."
  },
  {
    "pubmed": 21048031,
    "text": "Observational study of gene-disease association and gene-environment_
↪interaction. (HuGE Navigator)"
  },
  {
    "pubmed": 21062975,
    "text": "Data show that miR-302 simultaneously suppressed both the cyclin E-
↪CDK2 and cyclin D-CDK4/6 pathways to block>70% of the G1-S cell cycle transition."
  },
  {
    "pubmed": 21099355,
    "text": "Overexpression of human Cdk2 resulted in a defect in the G1 to S_
↪transition and a reduction in viability."
  },
  {
    "pubmed": 21233845,
    "text": "MicroRNA miR-885-5p targets CDK2 and MCM5, activates p53 and inhibits_
↪proliferation and survival."
  },
  {
    "pubmed": 21262353,
    "text": "Cdk2 functions via a Cdk2/SHP-1/beta-catenin/CEACAM1 axis, and show_
↪that Cdk2 has the capacity to regulate insulin internalization."
  },
  {
    "pubmed": 21264535,
    "text": "XPD may play an important role in cell apoptosis of hepatoma by_
↪inducing an over-expression of p53, but suppressing expressions of c-myc and cdk2"
  },
  {
    "pubmed": 21319273,
    "text": "CDK2 downregulation causes high apoptosis at the early time points"
  },
  {
    "pubmed": 21325496,
    "text": "Conclude that in cisplatin induced-kidney injury phosphorylation of_
↪p21 by Cdk2 limits the effectiveness of p21 to inhibit Cdk2."
  },
  {
    "pubmed": 21454540,
    "text": "the ability of Emil to inhibit APC/C is negatively regulated by CDKs"
  },
  {
    "pubmed": 21515670,
    "text": "cyclin E and CDK2 genes are key physiological effectors of the c-ETS1_
↪proto-oncogene. Furthermore, c-ETS1 is indispensable for the hepatotropic action of_
↪HBx in cell cycle deregulation."
  }

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 21565702,
      "text": "Transient binding of a second catalytic magnesium activates the
↪structure and dynamics of CDK2 kinase for catalysis."
    },
    {
      "pubmed": 21596315,
      "text": "The deubiquitinase USP37 binds CDH1 and removes degradative
↪polyubiquitin from cyclin A. USP37 was induced by E2F factors in G1, peaked at G1/S,
↪and was degraded in late mitosis. Phosphorylation of USP37 by CDK2 stimulated its
↪full activity."
    },
    {
      "pubmed": 21646351,
      "text": "anti-oncogenic role of miR-372 may be through control of cell growth
↪and cell cycle progression by down-regulating the cell cycle genes CDK2 and cyclin
↪A1"
    },
    {
      "pubmed": 21658603,
      "text": "Cdk2 is required for cell proliferation."
    },
    {
      "pubmed": 21769424,
      "text": "RT-PCR and Western blotting results revealed that both mRNA and
↪protein levels of CDK2 were significantly higher in tumor tissues."
    },
    {
      "pubmed": 21871181,
      "text": "NF-Y binds to CCAAT sequences in the Cyclin A promoter, as well as to
↪those in the promoters of cell cycle G2 regulators such as CDC2, Cyclin B and
↪CDC25C."
    },
    {
      "pubmed": 21918011,
      "text": "Epstein-Barr virus Rta-mediated transactivation of p21 and 14-3-3sigma
↪arrests cells at the G1/S transition by reducing cyclin E/CDK2 activity."
    },
    {
      "pubmed": 21941773,
      "text": "The expression level of CDK2 protein did not change significantly in
↪silica-induced human embryo lung fibroblasts."
    },
    {
      "pubmed": 21965652,
      "text": "excess of MCM3 up-regulates the phosphorylation of CHK1 Ser-345 and
↪CDK2 Thr-14."
    },
    {
      "pubmed": 22084169,
      "text": "The S-phase-specific cyclin-dependent kinase 2 was required for robust
↪activation of ATR in response to diverse chemotherapeutic agents."
    },
    {
      "pubmed": 22231403,
      "text": "The authors show that, in human and mouse, Mre11 controls these events
↪through a direct interaction with CDK2 that is required for CtIP phosphorylation
↪and BRCA1 interaction in normally dividing cells."
    }
  ]
}

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 22467868,
      "text": "Lin-28 homologue A (LIN28A) promotes cell cycle progression via
↪regulation of cyclin-dependent kinase 2 (CDK2), cyclin D1 (CCND1), and cell
↪division cycle 25 homolog A (CDC25A) expression in cancer."
    },
    {
      "pubmed": 22474407,
      "text": "CDK2 inhibition drastically diminishes anchorage-independent growth of
↪human cancer cells and cells transformed with various oncogenes"
    },
    {
      "pubmed": 22479189,
      "text": "low molecular weight cyclin E (LMW-E) requires CDK2-associated kinase
↪activity to induce mammary tumor formation by disrupting acinar development"
    },
    {
      "pubmed": 22673765,
      "text": "The activation of p21(Waf1/Cip1) was significantly up-regulated over
↪time, but there was no change in the level of CDK2 expression by treatment of
↪HEK293 cells with various concentrations of veterinary antibiotics."
    },
    {
      "pubmed": 22718829,
      "text": "Human cytomegalovirus IE1/2 expression was downregulated by cyclin A2,
↪CDK1 and CDK2."
    },
    {
      "pubmed": 22819841,
      "text": "exposure of cancer cells (such as HeLa and MCF7 cells) to H2O2
↪increased CDK2 activity with no accompanying change in the PCNA level, leading to
↪cell proliferation."
    },
    {
      "pubmed": 22927831,
      "text": "By a chemical-genetic approach study identified Nbs1 as a target of
↪Cdk2, and mapped the phosphorylation to a conserved CDK consensus recognition site."
    },
    {
      "pubmed": 22951823,
      "text": "cellular CDK2 phosphorylates the functionally critical S/T-P sites of
↪the hepadnavirus core CTD and is incorporated into viral capsids"
    },
    {
      "pubmed": 23028682,
      "text": "cyclin A-Cdk2 regulates apoptosis through a mechanism that involves
↪Rad9phosphorylation"
    },
    {
      "pubmed": 23065011,
      "text": "human papillomavirus E4 proteins can interact with cyclin A and cdk2,
↪which may contribute to viral manipulation of the host cell cycle."
    },
    {
      "pubmed": 23082202,
      "text": "Cdk2 also binds the N-terminal domain of Fbw7-gamma as well as SLP-1."
    }
  ]

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 23140174,
      "text": "CDK2 phosphorylates CDK9 on Ser 90 and thereby contributes to HIV-1_
↪transcription."
    },
    {
      "pubmed": 23184662,
      "text": "EEF2 phosphorylation by cyclin A-cyclin-dependent kinase 2 (CDK2) on a_
↪novel site, serine 595 (S595), directly regulates T56 phosphorylation by eEF2K."
    },
    {
      "pubmed": 23185313,
      "text": "This study aimed to explore the effects of single nucleotide_
↪polymorphisms in CDK2 and CCNE1 on breast cancer risk, progression and survival in_
↪a Chinese Han population."
    },
    {
      "pubmed": 23230143,
      "text": "Findings revealed a novel function of simultaneous p27 and CDK2_
↪cytoplasmic mislocalization in mediating growth-factor-regulated cell proliferation,
↪migration and invasion."
    },
    {
      "pubmed": 23300027,
      "text": "possible relationship between the CDK2 deleterious variants and the_
↪drug-binding ability"
    },
    {
      "pubmed": 23321641,
      "text": "Constitutive Cdk2 activity promotes aneuploidy while altering the_
↪spindle assembly and tetraploidy checkpoints."
    },
    {
      "pubmed": 23390492,
      "text": "Constitutive CCND1/CDK2 expression contributes to neoplastic mammary_
↪epithelial cell transformation."
    },
    {
      "pubmed": 23390529,
      "text": "The prolyl isomerase Pin1 acts synergistically with CDK2 to regulate_
↪the basal activity of estrogen receptor alpha in breast cancer."
    },
    {
      "pubmed": 23446853,
      "text": "Aurora-A kinase-induced centrosome amplification was mediated by Cdk2_
↪kinase."
    },
    {
      "pubmed": 23479742,
      "text": "the up-regulation of CDK2 by CUL4B is achieved via the repression of_
↪miR-372 and miR-373, which target CDK2."
    },
    {
      "pubmed": 23532886,
      "text": "Data indicate that TG02 blocked signaling by CDKs 1, 2, 7, and 9 and_
↪ERK5, leading to potent and highly consistent antimyeloma activity."
    }
  ]

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 23643165,
      "text": "The expression of CDK2 mRNA significantly decreased in P(CDK2-siRNA).",
    },
    {
      "pubmed": 23671119,
      "text": "A specific and essential roles for Cdk2 inhibitory phosphorylation in
↪the successful execution of the replication stress checkpoint response and in
↪maintaining genome integrity.",
    },
    {
      "pubmed": 23720738,
      "text": "MCM7 is a substrate of cyclin E/Cdk2 and can be phosphorylated on Ser-
↪121.",
    },
    {
      "pubmed": 23727278,
      "text": "Data indicate that different binding sites of cyclin-dependent kinase
↪(CDK2) contributing towards the binding of inhibitors.",
    },
    {
      "pubmed": 23737759,
      "text": "CDK7 involved in phosphorylation/activation of CDK4 and CDK6;
↪existence of CDK4-activating kinase(s) other than CDK7; and novel CDK7-dependent
↪positive feedbacks mediated by p21 phosphorylation by CDK4 and CDK2 to sustain CDK4
↪activation.",
    },
    {
      "pubmed": 23776131,
      "text": "FBXO28 activity and stability are regulated during the cell cycle by
↪CDK1/2-mediated phosphorylation of FBXO28, which is required for its efficient
↪ubiquitylation of MYC.",
    },
    {
      "pubmed": 23781148,
      "text": "antitumor effects of DOC-1R may be mediated by negatively regulating
↪G1 phase progression and G1/S transition through inhibiting CDK2 expression and
↪activation",
    },
    {
      "pubmed": 23787073,
      "text": "This study indicates that genetic polymorphisms of AURKA, BRCA1 and
↪CCNE1 may affect ovarian cancer susceptibility in Chinese Han women.",
    },
    {
      "pubmed": 24075009,
      "text": "Cells decide at the end of mitosis to either start the next cell cycle
↪by immediately building up CDK2 activity or to enter a transient G0-like state by
↪suppressing CDK2 activity.",
    },
    {
      "pubmed": 24204256,
      "text": "PKC activation then triggered activation of cdk-2, which became
↪further activated by caspase-3.",
    },
    {

```

(continues on next page)

(continued from previous page)

```

    "pubmed": 24216307,
    "text": "Two nuclear export signals of Cdc6 work cooperatively and distinctly_
↪for the cytoplasmic translocation of Cdc6 phosphorylated by cyclin A/Cdk2."
  },
  {
    "pubmed": 24240190,
    "text": "CDK2 knockdown alters the profile of Rb phosphorylation in coronary_
↪artery smooth muscle cells, as well as the proliferative response of these cells to_
↪mitogenic stimulation."
  },
  {
    "pubmed": 24386425,
    "text": "Of the total, the deregulation of several genes (CDK1, CDK2, CDK4,_
↪MCM2, MCM3, MCM4, EIF3a and RPN2) were potentially associated with disease_
↪development and progression."
  },
  {
    "pubmed": 24444383,
    "text": "MYC-dependent breast cancer cells possess high MYC expression and high_
↪level of MYC phosphorylation, but are not sensitive to inhibition of CDK2."
  },
  {
    "pubmed": 24520316,
    "text": "CRIF1 may play a regulatory role in the BM microenvironment-induced_
↪leukemia cell cycle arrest possibly through interacting with CDK2 and acting as a_
↪cyclin-dependent kinase inhibitor."
  },
  {
    "pubmed": 24623419,
    "text": "Authors identified and validated two additional host proteins_
↪interacting with human SAMHD1, namely, cyclin-dependent kinase 2 (CDK2) and S-phase_
↪kinase-associated protein 2 (SKP2)."
  },
  {
    "pubmed": 24671051,
    "text": "Expression of Notch1, -2, and -3, CDK2, and CCNE1 was significantly_
↪decreased by upregulation of ALDH1A1 in A549 cells, but increased by its_
↪interruption in A549s cells."
  },
  {
    "pubmed": 24700371,
    "text": "In the subsequent molecular experiments, western blot analysis and_
↪kinase activity detection demonstrated that TAMs can significantly boost the_
↪expression levels and activities of CDK2 and CDK4 in SKOV3 cells."
  },
  {
    "pubmed": 24820417,
    "text": "Results show that CDK2 phosphorylates Thr-156 in GATA3."
  },
  {
    "pubmed": 24911186,
    "text": "Report structure-based discovery of allosteric inhibitors of CDK2."
  },
  {
    "pubmed": 24922574,
    "text": "CDK2 Supports HIV-1 Reverse Transcription in CD4+ T Cells.HIV-1_
↪reverse transcriptase Is a Substrate for CDK2-Dependent Phosphorylation"
  }

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 24935000,
      "text": "It is concluded that non-response to everolimus is characterized by
↪increased cdk2/cyclin A, driving RCC cells into the G2/M-phase. VPA hinders
↪everolimus non-response by diminishing cdk2/cyclin A."
    },
    {
      "pubmed": 24947816,
      "text": "More effective packing and interactions between CDK2 and LMW cyclin E
↪isoforms, however, produce more efficient protein-protein complexes that accelerate
↪the cell division processes in cancer cells, where these cyclin E isoforms are
↪overexpressed."
    },
    {
      "pubmed": 25015816,
      "text": "CDK2 was strongly linked to cell cycle progression and coordinated
↪SAMHD1 phosphorylation and inactivation."
    },
    {
      "pubmed": 25071185,
      "text": "Cdk1 activity blocks lysosomal degradation of HIF-1alpha and increases
↪HIF-1alpha protein stability and transcriptional activity. By contrast, Cdk2
↪activity promotes lysosomal degradation of HIF-1alpha at the G1/S phase transition."
    },
    {
      "pubmed": 25136960,
      "text": "A positive correlation between cdk2/cyclin A expression level and
↪tumor growth. Amygdalin, therefore, may block tumor growth."
    },
    {
      "pubmed": 25149358,
      "text": "for both oncogene- and DNA damage-induced cellular senescence, CDK2
↪transcript and protein are decreased in a p53- and RB-dependent manner, and this
↪repression is necessary for cell-cycle exit during senescence"
    },
    {
      "pubmed": 25154617,
      "text": "Which is mutated at the CDK2 phosphorylation site."
    },
    {
      "pubmed": 25218592,
      "text": "The Cell Cycle Profiling - Risk Score (C2P-RS) based on CDK1 and CDK2
↪specific activities was significantly associated with relapse in breast cancers."
    },
    {
      "pubmed": 25218637,
      "text": "Data indicate that tumour suppressor RASSF1A triggers large tumor
↪suppressor kinase 1 (LATS)-CDK2 interaction and restricts CDK2 kinase activity
↪towards BRCA2."
    },
    {
      "pubmed": 25220500,
      "text": "Cyclin A2 and its associated kinase (CDK2) activity are required for
↪optimal induction of progesterone receptor target genes in breast cancer cells."
    },
    {

```

(continues on next page)

(continued from previous page)

```

    "pubmed": 25265349,
    "text": "High CDK2 expression is associated with nasopharyngeal carcinoma."
  },
  {
    "pubmed": 25271736,
    "text": "observations suggested that androgen suppresses the proliferation of
↪CRPC cells partially through inhibition of Cyclin A, Cdk2, and Skp2"
  },
  {
    "pubmed": 25303791,
    "text": "TPPII, MYBBP1A and CDK2 form a protein-protein interaction network."
  },
  {
    "pubmed": 25410660,
    "text": "Inhibition of CDK2 phosphorylation blocked phosphorylation of hnRNP K,
↪preventing its incorporation into stress granules (SGs). Due to interaction between
↪hnRNP K with TDP-43, the loss of hnRNP K from SGs prevented accumulation of TDP-43."
  },
  {
    "pubmed": 25443276,
    "text": "At a median follow-up of 36 months (1-109M), tumor with low CDK2SA-
↪CDK1SA ratio showed significantly better 5-year recurrence-free survival than those
↪with high CDK2SA-CDK1SA ratio (88.7% vs. 54.7%, P = 0.00141)."
  },
  {
    "pubmed": 25451924,
    "text": "miR-638 regulates proliferation and myeloid differentiation by
↪targeting CDK2 and may serve as a novel target for leukemia therapy or marker for
↪AML diagnosis and prognosis"
  },
  {
    "pubmed": 25463638,
    "text": "No association of CDK2 polymorphisms with risk of endometrial
↪carcinoma found in Chinese Han women."
  },
  {
    "pubmed": 25501982,
    "text": "HOXA7 promotes cell proliferation, and these changes are mediated by
↪cyclin E1/CDK2"
  },
  {
    "pubmed": 25541464,
    "text": "Using the fact that deletion of the yeast CDC28 gene is functionally
↪complemented by human CDK1 or CDK2, we set up an in vivo screen system to evaluate
↪the inhibitory potency of purine derivatives against these two human Cdks."
  },
  {
    "pubmed": 25728284,
    "text": "CDK2 up-regulates the protein level of KLF10 through reducing its
↪association with SIAH1, a KLF10 E3-ubiquitin ligase involved in proteasomal
↪degradation."
  },
  {
    "pubmed": 25744732,
    "text": "Diclofenac and curcumin overcome these carcinogenic effects by
↪downregulating telomerase activity, diminishing the expression of TERT, CDK4, CDK2,
↪cyclin D1, and cyclin E."
  }

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "pubmed": 25754137,
      "text": "The docking and molecular dynamics investigation performed here led to
↳the identification of the interactions responsible for stabilizing the ligand
↳ChEMBL474807 at the active sites of the glycogen synthase kinase-3beta (GSK-3) and
↳cyclin-dependent kinase-2"
    },
    {
      "pubmed": 25808870,
      "text": "CP110 plays a mechanistic role in response of lung cancer cells to
↳CDK2 inhibition, especially in the presence of activated KRAS mutations."
    },
    {
      "pubmed": 25832654,
      "text": "NUAK2 silencing and inactivation of the PI3K pathway efficiently
↳controlled CDK2 expression, whereas CDK2 inactivation specifically abrogated the
↳growth of NUA2-amplified and PTEN-deficient melanoma cells."
    },
    {
      "pubmed": 25860957,
      "text": "Identified ING5 as a novel CDK2 substrate. ING5 is phosphorylated at a
↳single site, threonine 152, by cyclin E/CDK2 and cyclin A/CDK2. This site is also
↳phosphorylated in cells in a cell cycle dependent manner, consistent with it being
↳a CDK2 substrate."
    },
    {
      "pubmed": 25918937,
      "text": "analysis of the conformational characteristics and ligand binding
↳mechanisms of CDK2 [review]"
    },
    {
      "pubmed": 26026083,
      "text": "G1 arrest induced by SB265610 occurred at concentrations lacking CXCR2
↳selectivity and revealed cyclin-dependent kinase 2 (CDK2) (Thr160)
↳hypophosphorylation, cyclin D3 gene down-regulation, and p21 post-translational
↳induction"
    },
    {
      "pubmed": 26124340,
      "text": "We found no significant associations for CDKN2 p16 580 C>T and MDM2
↳SNP309 T>G variants between cases and controls."
    },
    {
      "pubmed": 26139602,
      "text": "Sox2 phosphorylation by Cdk2 promotes the establishment but not the
↳maintenance of the pluripotent state."
    },
    {
      "pubmed": 26147897,
      "text": "fluspirilene is a potential CDK2 inhibitor and a candidate anti-cancer
↳drug for the treatment of human hepatocellular carcinoma."
    },
    {
      "pubmed": 26151768,
      "text": "In G28 cells, a dosedependent induction of CDK2, p21 and cyclin D was
↳observed between 10 and 50 microM roscovitine after 72 h, however, at the highest
↳concentration of 100 microM, all investigated genes were downregulated.(continues on next page)

```

(continued from previous page)

```

    },
    {
      "pubmed": 26204491,
      "text": "ovary tumors with elevated CCNE1 expression may be staged for Cdk2-
↪targeted therapy"
    },
    {
      "pubmed": 26297806,
      "text": "Centriolar satellites build a centrosomal microcephaly protein complex,
↪critical for human neurodevelopment that promotes CDK2 centrosomal localization and,
↪centriole duplication."
    },
    {
      "pubmed": 26373553,
      "text": "PIWIL2 has a role in promoting progression of non-small cell lung,
↪cancer by inducing CDK2 and Cyclin A expression"
    },
    {
      "pubmed": 26555773,
      "text": "both cell lines feature a significant reduction of CDK2 expression,
↪verified at the RNA and protein level, respectively"
    }
  ],
  "genomic_pos": {
    "chr": "12",
    "end": 55972784,
    "start": 55966769,
    "strand": 1
  },
  "genomic_pos_hg19": {
    "chr": "12",
    "end": 56366568,
    "start": 56360553,
    "strand": 1
  },
  "go": {
    "BP": [
      {
        "evidence": "TAS",
        "id": "GO:0000082",
        "term": "G1/S transition of mitotic cell cycle"
      },
      {
        "evidence": "NAS",
        "id": "GO:0000086",
        "pubmed": 1653904,
        "term": "G2/M transition of mitotic cell cycle"
      },
      {
        "evidence": "TAS",
        "id": "GO:0000086",
        "term": "G2/M transition of mitotic cell cycle"
      },
      {
        "evidence": "IEA",
        "id": "GO:0002088",
        "term": "lens development in camera-type eye"
      }
    ]
  }
}

```

(continues on next page)

```

    },
    {
      "evidence": "TAS",
      "id": "GO:0006260",
      "pubmed": 19238148,
      "term": "DNA replication"
    },
    {
      "evidence": "IEA",
      "id": "GO:0006281",
      "term": "DNA repair"
    },
    {
      "evidence": "IEA",
      "id": "GO:0006813",
      "term": "potassium ion transport"
    },
    {
      "evidence": "TAS",
      "id": "GO:0006977",
      "term": "DNA damage response, signal transduction by p53 class mediator,
↳resulting in cell cycle arrest"
    },
    {
      "evidence": "IEA",
      "id": "GO:0007067",
      "term": "mitotic nuclear division"
    },
    {
      "evidence": "IMP",
      "id": "GO:0007099",
      "pubmed": 26297806,
      "term": "centriole replication"
    },
    {
      "evidence": "TAS",
      "id": "GO:0007126",
      "pubmed": 19238148,
      "term": "meiotic nuclear division"
    },
    {
      "evidence": "IEP",
      "id": "GO:0007265",
      "pubmed": 9054499,
      "term": "Ras protein signal transduction"
    },
    {
      "evidence": "IDA",
      "id": "GO:0008284",
      "pubmed": 10767298,
      "term": "positive regulation of cell proliferation"
    },
    {
      "evidence": "IEA",
      "id": "GO:0009636",
      "term": "response to toxic substance"
    },
  },

```

(continues on next page)

(continued from previous page)

```

{
  "evidence": "IEA",
  "id": "GO:0016572",
  "term": "histone phosphorylation"
},
{
  "evidence": "IDA",
  "id": "GO:0018105",
  "pubmed": 23184662,
  "term": "peptidyl-serine phosphorylation"
},
{
  "evidence": "IEA",
  "id": "GO:0031100",
  "term": "organ regeneration"
},
{
  "evidence": "TAS",
  "id": "GO:0031571",
  "pubmed": 21319273,
  "term": "mitotic G1 DNA damage checkpoint"
},
{
  "evidence": "IEA",
  "id": "GO:0032298",
  "term": "positive regulation of DNA-dependent DNA replication initiation"
},
{
  "evidence": "IEA",
  "id": "GO:0032355",
  "term": "response to estradiol"
},
{
  "evidence": "IEA",
  "id": "GO:0032869",
  "term": "cellular response to insulin stimulus"
},
{
  "evidence": "IEA",
  "id": "GO:0042493",
  "term": "response to drug"
},
{
  "evidence": "IEA",
  "id": "GO:0045471",
  "term": "response to ethanol"
},
{
  "evidence": "IEA",
  "id": "GO:0045893",
  "term": "positive regulation of transcription, DNA-templated"
},
{
  "evidence": "IEA",
  "id": "GO:0046686",
  "term": "response to cadmium ion"
},
},

```

(continues on next page)

(continued from previous page)

```

    {
      "evidence": "TAS",
      "id": "GO:0051298",
      "pubmed": 19238148,
      "term": "centrosome duplication"
    },
    {
      "evidence": "IEA",
      "id": "GO:0051301",
      "term": "cell division"
    },
    {
      "evidence": "TAS",
      "id": "GO:0051436",
      "term": "negative regulation of ubiquitin-protein ligase activity involved in_
↪mitotic cell cycle"
    },
    {
      "evidence": "TAS",
      "id": "GO:0051439",
      "term": "regulation of ubiquitin-protein ligase activity involved in mitotic_
↪cell cycle"
    },
    {
      "evidence": "IEA",
      "id": "GO:0051591",
      "term": "response to cAMP"
    },
    {
      "evidence": "IEA",
      "id": "GO:0051602",
      "term": "response to electrical stimulus"
    },
    {
      "evidence": "IDA",
      "id": "GO:0060968",
      "pubmed": 20935635,
      "term": "regulation of gene silencing"
    },
    {
      "evidence": "TAS",
      "id": "GO:0071732",
      "pubmed": 20079829,
      "term": "cellular response to nitric oxide"
    },
    {
      "evidence": "TAS",
      "id": "GO:1901796",
      "term": "regulation of signal transduction by p53 class mediator"
    }
  ],
  "CC": [
    {
      "evidence": "IDA",
      "id": "GO:0000307",
      "pubmed": 8692841,
      "term": "cyclin-dependent protein kinase holoenzyme complex"
    }
  ]

```

(continues on next page)

(continued from previous page)

```
},
{
  "evidence": "IEA",
  "id": "GO:0000781",
  "term": "chromosome, telomeric region"
},
{
  "evidence": "IEA",
  "id": "GO:0000793",
  "term": "condensed chromosome"
},
{
  "evidence": "IEA",
  "id": "GO:0000805",
  "term": "X chromosome"
},
{
  "evidence": "IEA",
  "id": "GO:0000806",
  "term": "Y chromosome"
},
{
  "evidence": "IDA",
  "id": "GO:0005634",
  "pubmed": 10767298,
  "term": "nucleus"
},
{
  "evidence": "TAS",
  "id": "GO:0005654",
  "term": "nucleoplasm"
},
{
  "evidence": "IEA",
  "id": "GO:0005667",
  "term": "transcription factor complex"
},
{
  "evidence": "IDA",
  "id": "GO:0005737",
  "pubmed": 10767298,
  "term": "cytoplasm"
},
{
  "evidence": "IDA",
  "id": "GO:0005768",
  "pubmed": 21262353,
  "term": "endosome"
},
{
  "evidence": "TAS",
  "id": "GO:0005813",
  "pubmed": 19238148,
  "term": "centrosome"
},
{
  "evidence": "TAS",
```

(continues on next page)

(continued from previous page)

```
    "id": "GO:0005829",
    "term": "cytosol"
  },
  {
    "evidence": "IDA",
    "id": "GO:0015030",
    "pubmed": 10995387,
    "term": "Cajal body"
  }
],
"MF": [
  {
    "evidence": "TAS",
    "id": "GO:0004674",
    "term": "protein serine/threonine kinase activity"
  },
  {
    "evidence": "IDA",
    "id": "GO:0004693",
    "pubmed": 21596315,
    "term": "cyclin-dependent protein serine/threonine kinase activity"
  },
  {
    "evidence": "TAS",
    "id": "GO:0004693",
    "term": "cyclin-dependent protein serine/threonine kinase activity"
  },
  {
    "evidence": "IPI",
    "id": "GO:0005515",
    "pubmed": [
      8242750,
      8521818,
      8684460,
      8756328,
      8756624,
      9840943,
      10330164,
      11463386,
      11980914,
      12244298,
      12361598,
      12839962,
      12941338,
      15107404,
      15178429,
      15189033,
      15232106,
      15239650,
      15611625,
      15890360,
      16209941,
      16326706,
      16458891,
      16765349,
      16962592,
      17053782,
```

(continues on next page)

(continued from previous page)

```

17254966,
17254967,
17418410,
19150984,
19829063,
20098747,
20871633,
21092281,
21596315,
21952639,
23082202,
23455922,
23602568,
23853094,
24218572,
25241761,
25416956,
25852190,
26496610
],
  "term": "protein binding"
},
{
  "evidence": "IEA",
  "id": "GO:0005524",
  "term": "ATP binding"
},
{
  "evidence": "TAS",
  "id": "GO:0016301",
  "term": "kinase activity"
},
{
  "evidence": "IDA",
  "id": "GO:0030332",
  "pubmed": 1653904,
  "term": "cyclin binding"
},
{
  "evidence": "IEA",
  "id": "GO:0032403",
  "term": "protein complex binding"
},
{
  "evidence": "IDA",
  "id": "GO:0035173",
  "pubmed": 8692841,
  "qualifier": "contributes_to",
  "term": "histone kinase activity"
},
{
  "evidence": "IEA",
  "id": "GO:0046872",
  "term": "metal ion binding"
}
]
},

```

(continues on next page)

(continued from previous page)

```
"homologene": {
  "genes": [
    [
      9606,
      1017
    ],
    [
      10090,
      12566
    ],
    [
      10116,
      362817
    ],
    [
      7227,
      42453
    ],
    [
      7955,
      406715
    ],
    [
      3702,
      824036
    ],
    [
      8364,
      493498
    ],
    [
      4530,
      4328135
    ],
    [
      4530,
      4331415
    ],
    [
      4896,
      2539869
    ],
    [
      4932,
      852457
    ],
    [
      5141,
      3876264
    ],
    [
      7165,
      3291042
    ],
    [
      9031,
      100529062
    ]
  ]
}
```

(continues on next page)

(continued from previous page)

```

    ],
    [
      9544,
      711002
    ],
    [
      9598,
      467032
    ],
    [
      9615,
      100855704
    ],
    [
      9913,
      519217
    ],
    [
      28985,
      2896999
    ],
    [
      33169,
      4620303
    ],
    [
      318829,
      2679140
    ]
  ],
  "id": 74409
},
"interpro": [
  {
    "desc": "Protein kinase-like domain",
    "id": "IPR011009",
    "short_desc": "Kinase-like_dom"
  },
  {
    "desc": "Serine/threonine-protein kinase, active site",
    "id": "IPR008271",
    "short_desc": "Ser/Thr_kinase_AS"
  },
  {
    "desc": "Serine/threonine/dual specificity protein kinase, catalytic domain",
    "id": "IPR002290",
    "short_desc": "Ser/Thr_dual-sp_kinase"
  },
  {
    "desc": "Protein kinase domain",
    "id": "IPR000719",
    "short_desc": "Prot_kinase_dom"
  },
  {
    "desc": "Protein kinase, ATP binding site",
    "id": "IPR017441",
    "short_desc": "Protein_kinase_ATP_BS"
  }
]

```

(continues on next page)

(continued from previous page)

```

    }
  ],
  "ipi": [
    "IPI00031681",
    "IPI00910650"
  ],
  "map_location": "12q13",
  "name": "cyclin dependent kinase 2",
  "pathway": {
    "biocarta": [
      {
        "id": "cellcyclepathway",
        "name": "cyclins and cell cycle regulation"
      },
      {
        "id": "efppathway",
        "name": "estrogen responsive protein efp controls cell cycle and breast_
↪tumors growth"
      },
      {
        "id": "fbw7pathway",
        "name": "cyclin e destruction pathway"
      },
      {
        "id": "g1pathway",
        "name": "cell cycle: g1/s check point"
      },
      {
        "id": "mcmpathway",
        "name": "cdk regulation of dna replication"
      },
      {
        "id": "p27pathway",
        "name": "regulation of p27 phosphorylation during cell cycle progression"
      },
      {
        "id": "p53pathway",
        "name": "p53 signaling pathway"
      },
      {
        "id": "raccycdpathway",
        "name": "influence of ras and rho proteins on g1 to s transition"
      },
      {
        "id": "rbpathway",
        "name": "rb tumor suppressor/checkpoint signaling in response to dna damage"
      },
      {
        "id": "skp2e2fpathway",
        "name": "e2f1 destruction pathway"
      }
    ]
  },
  "kegg": [
    {
      "id": "hsa04068",
      "name": "FoxO signaling pathway - Homo sapiens (human)"
    }
  ],

```

(continues on next page)

(continued from previous page)

```

{
  "id": "hsa04110",
  "name": "Cell cycle - Homo sapiens (human)"
},
{
  "id": "hsa04114",
  "name": "Oocyte meiosis - Homo sapiens (human)"
},
{
  "id": "hsa04115",
  "name": "p53 signaling pathway - Homo sapiens (human)"
},
{
  "id": "hsa04151",
  "name": "PI3K-Akt signaling pathway - Homo sapiens (human)"
},
{
  "id": "hsa04914",
  "name": "Progesterone-mediated oocyte maturation - Homo sapiens (human)"
},
{
  "id": "hsa05161",
  "name": "Hepatitis B - Homo sapiens (human)"
},
{
  "id": "hsa05162",
  "name": "Measles - Homo sapiens (human)"
},
{
  "id": "hsa05168",
  "name": "Herpes simplex infection - Homo sapiens (human)"
},
{
  "id": "hsa05169",
  "name": "Epstein-Barr virus infection - Homo sapiens (human)"
},
{
  "id": "hsa05200",
  "name": "Pathways in cancer - Homo sapiens (human)"
},
{
  "id": "hsa05203",
  "name": "Viral carcinogenesis - Homo sapiens (human)"
},
{
  "id": "hsa05215",
  "name": "Prostate cancer - Homo sapiens (human)"
},
{
  "id": "hsa05222",
  "name": "Small cell lung cancer - Homo sapiens (human)"
}
],
"netpath": [
  {
    "id": "Pathway_BCR",
    "name": "BCR"
  }
]

```

(continues on next page)

(continued from previous page)

```
    },
    {
      "id": "Pathway_EGFR1",
      "name": "EGFR1"
    },
    {
      "id": "Pathway_ID",
      "name": "ID"
    },
    {
      "id": "Pathway_IL2",
      "name": "IL2"
    },
    {
      "id": "Pathway_KitReceptor",
      "name": "KitReceptor"
    },
    {
      "id": "Pathway_RAGE",
      "name": "RAGE"
    },
    {
      "id": "Pathway_TGF_beta_Receptor",
      "name": "TGF_beta_Receptor"
    }
  ],
  "pid": [
    {
      "id": "atr_pathway",
      "name": "ATR signaling pathway"
    },
    {
      "id": "bard1pathway",
      "name": "BARD1 signaling events"
    },
    {
      "id": "e2f_pathway",
      "name": "E2F transcription factor network"
    },
    {
      "id": "foxm1pathway",
      "name": "FOXM1 transcription factor network"
    },
    {
      "id": "foxopathway",
      "name": "FoxO family signaling"
    },
    {
      "id": "il2_1pathway",
      "name": "IL2-mediated signaling events"
    },
    {
      "id": "mtor_4pathway",
      "name": "mTOR signaling pathway"
    },
    {
      "id": "p53regulationpathway",
```

(continues on next page)

(continued from previous page)

```

    "name": "p53 pathway"
  },
  {
    "id": "p73pathway",
    "name": "p73 transcription factor network"
  },
  {
    "id": "prlsignalingeventspathway",
    "name": "Signaling events mediated by PRL"
  },
  {
    "id": "rb_1pathway",
    "name": "Regulation of retinoblastoma protein"
  },
  {
    "id": "smad2_3nuclearpathway",
    "name": "Regulation of nuclear SMAD2/3 signaling"
  }
],
"reactome": [
  {
    "id": "R-HSA-109582",
    "name": "Hemostasis"
  },
  {
    "id": "R-HSA-1538133",
    "name": "G0 and Early G1"
  },
  {
    "id": "R-HSA-1640170",
    "name": "Cell Cycle"
  },
  {
    "id": "R-HSA-174143",
    "name": "APC/C-mediated degradation of cell cycle proteins"
  },
  {
    "id": "R-HSA-176187",
    "name": "Activation of ATR in response to replication stress"
  },
  {
    "id": "R-HSA-176408",
    "name": "Regulation of APC/C activators between G1/S and early anaphase"
  },
  {
    "id": "R-HSA-187577",
    "name": "SCF (Skp2)-mediated degradation of p27/p21"
  },
  {
    "id": "R-HSA-2262752",
    "name": "Cellular responses to stress"
  },
  {
    "id": "R-HSA-2559582",
    "name": "Senescence-Associated Secretory Phenotype (SASP)"
  }
]

```

(continues on next page)

(continued from previous page)

```

    "id": "R-HSA-2559583",
    "name": "Cellular Senescence"
  },
  {
    "id": "R-HSA-2559586",
    "name": "DNA Damage/Telomere Stress Induced Senescence"
  },
  {
    "id": "R-HSA-453274",
    "name": "Mitotic G2-G2/M phases"
  },
  {
    "id": "R-HSA-453276",
    "name": "Regulation of mitotic cell cycle"
  },
  {
    "id": "R-HSA-453279",
    "name": "Mitotic G1-G1/S phases"
  },
  {
    "id": "R-HSA-68874",
    "name": "M/G1 Transition"
  },
  {
    "id": "R-HSA-68911",
    "name": "G2 Phase"
  },
  {
    "id": "R-HSA-68949",
    "name": "Orcl removal from chromatin"
  },
  {
    "id": "R-HSA-68962",
    "name": "Activation of the pre-replicative complex"
  },
  {
    "id": "R-HSA-69002",
    "name": "DNA Replication Pre-Initiation"
  },
  {
    "id": "R-HSA-69017",
    "name": "CDK-mediated phosphorylation and removal of Cdc6"
  },
  {
    "id": "R-HSA-69052",
    "name": "Switching of origins to a post-replicative state"
  },
  {
    "id": "R-HSA-69200",
    "name": "Phosphorylation of proteins involved in G1/S transition by active_
↪Cyclin E:Cdk2 complexes"
  },
  {
    "id": "R-HSA-69202",
    "name": "Cyclin E associated events during G1/S transition "
  },
  {

```

(continues on next page)

(continued from previous page)

```

    "id": "R-HSA-69206",
    "name": "G1/S Transition"
  },
  {
    "id": "R-HSA-69239",
    "name": "Synthesis of DNA"
  },
  {
    "id": "R-HSA-69242",
    "name": "S Phase"
  },
  {
    "id": "R-HSA-69273",
    "name": "Cyclin A/B1 associated events during G2/M transition"
  },
  {
    "id": "R-HSA-69275",
    "name": "G2/M Transition"
  },
  {
    "id": "R-HSA-69278",
    "name": "Cell Cycle, Mitotic"
  },
  {
    "id": "R-HSA-69300",
    "name": "Removal of licensing factors from origins"
  },
  {
    "id": "R-HSA-69304",
    "name": "Regulation of DNA replication"
  },
  {
    "id": "R-HSA-69306",
    "name": "DNA Replication"
  },
  {
    "id": "R-HSA-69481",
    "name": "G2/M Checkpoints"
  },
  {
    "id": "R-HSA-69563",
    "name": "p53-Dependent G1 DNA Damage Response"
  },
  {
    "id": "R-HSA-69580",
    "name": "p53-Dependent G1/S DNA damage checkpoint"
  },
  {
    "id": "R-HSA-69615",
    "name": "G1/S DNA Damage Checkpoints"
  },
  {
    "id": "R-HSA-69620",
    "name": "Cell Cycle Checkpoints"
  },
  {
    "id": "R-HSA-69656",

```

(continues on next page)

(continued from previous page)

```
    "name": "Cyclin A:Cdk2-associated events at S phase entry"
  },
  {
    "id": "R-HSA-983231",
    "name": "Factors involved in megakaryocyte development and platelet production"
  }
],
"wikipathways": [
  {
    "id": "WP1530",
    "name": "miRNA Regulation of DNA Damage Response"
  },
  {
    "id": "WP179",
    "name": "Cell Cycle"
  },
  {
    "id": "WP2032",
    "name": "TSH signaling pathway"
  },
  {
    "id": "WP2261",
    "name": "Signaling Pathways in Glioblastoma"
  },
  {
    "id": "WP2374",
    "name": "Oncostatin M Signaling Pathway"
  },
  {
    "id": "WP2377",
    "name": "Integrated Pancreatic Cancer Pathway"
  },
  {
    "id": "WP2431",
    "name": "Spinal Cord Injury"
  },
  {
    "id": "WP2446",
    "name": "Retinoblastoma (RB) in Cancer"
  },
  {
    "id": "WP2586",
    "name": "Aryl Hydrocarbon Receptor"
  },
  {
    "id": "WP2877",
    "name": "Vitamin D Receptor Pathway"
  },
  {
    "id": "WP45",
    "name": "G1 to S cell cycle control"
  },
  {
    "id": "WP466",
    "name": "DNA Replication"
  }
],
```

(continues on next page)

(continued from previous page)

```
{
  "id": "WP53",
  "name": "ID signaling pathway"
},
{
  "id": "WP707",
  "name": "DNA Damage Response"
}
]
},
"pdb": [
  "1AQ1",
  "1B38",
  "1B39",
  "1BUH",
  "1CKP",
  "1DI8",
  "1DM2",
  "1E1V",
  "1E1X",
  "1E9H",
  "1F5Q",
  "1FIN",
  "1FQ1",
  "1FVT",
  "1FVV",
  "1G5S",
  "1GIH",
  "1GII",
  "1GIJ",
  "1GY3",
  "1GZ8",
  "1H00",
  "1H01",
  "1H07",
  "1H08",
  "1H0V",
  "1H0W",
  "1H1P",
  "1H1Q",
  "1H1R",
  "1H1S",
  "1H24",
  "1H25",
  "1H26",
  "1H27",
  "1H28",
  "1HCK",
  "1HCL",
  "1JST",
  "1JSU",
  "1JSV",
  "1JVP",
  "1KE5",
  "1KE6",
  "1KE7",
  "1KE8",
```

(continues on next page)

(continued from previous page)

```
"1KE9",  
"1OGU",  
"1OI9",  
"1OIQ",  
"1OIR",  
"1OIT",  
"1OIU",  
"1Oiy",  
"1OKV",  
"1OKW",  
"1OL1",  
"1OL2",  
"1P2A",  
"1P5E",  
"1PF8",  
"1PKD",  
"1PW2",  
"1PXI",  
"1PXJ",  
"1P XK",  
"1PXL",  
"1PXM",  
"1PXN",  
"1PXO",  
"1PXP",  
"1PYE",  
"1QMZ",  
"1R78",  
"1URC",  
"1URW",  
"1V1K",  
"1VYW",  
"1VYZ",  
"1W0X",  
"1W8C",  
"1W98",  
"1WCC",  
"1Y8Y",  
"1Y91",  
"1YKR",  
"2A0C",  
"2A4L",  
"2B52",  
"2B53",  
"2B54",  
"2B55",  
"2BHE",  
"2BHH",  
"2BKZ",  
"2BPM",  
"2BTR",  
"2BTS",  
"2C4G",  
"2C5N",  
"2C5O",  
"2C5V",  
"2C5X",
```

(continues on next page)

(continued from previous page)

```
"2C5Y",  
"2C68",  
"2C69",  
"2C6I",  
"2C6K",  
"2C6L",  
"2C6M",  
"2C6O",  
"2C6T",  
"2CCH",  
"2CCI",  
"2CJM",  
"2CLX",  
"2DS1",  
"2DUV",  
"2EXM",  
"2FVD",  
"2G9X",  
"2HIC",  
"2I40",  
"2IW6",  
"2IW8",  
"2IW9",  
"2J9M",  
"2JGZ",  
"2R3F",  
"2R3G",  
"2R3H",  
"2R3I",  
"2R3J",  
"2R3K",  
"2R3L",  
"2R3M",  
"2R3N",  
"2R3O",  
"2R3P",  
"2R3Q",  
"2R3R",  
"2R64",  
"2UUE",  
"2UZB",  
"2UZD",  
"2UZE",  
"2UZL",  
"2UZN",  
"2UZO",  
"2V0D",  
"2V22",  
"2VTA",  
"2VTH",  
"2VTI",  
"2VTJ",  
"2VTL",  
"2VTM",  
"2VTN",  
"2VTO",  
"2VTP",
```

(continues on next page)

(continued from previous page)

```
"2VTQ",  
"2VTR",  
"2VTS",  
"2VTT",  
"2VU3",  
"2VV9",  
"2W05",  
"2W06",  
"2W17",  
"2W1H",  
"2WEV",  
"2WFY",  
"2WHB",  
"2WIH",  
"2WIP",  
"2WMA",  
"2WMB",  
"2WPA",  
"2WXV",  
"2X1N",  
"2XMY",  
"2XNB",  
"3BHT",  
"3BHU",  
"3BHV",  
"3DDP",  
"3DDQ",  
"3DOG",  
"3EID",  
"3EJ1",  
"3EOC",  
"3EZR",  
"3EZV",  
"3F5X",  
"3FZ1",  
"3IG7",  
"3IGG",  
"3LE6",  
"3LFN",  
"3LFQ",  
"3LFS",  
"3MY5",  
"3NS9",  
"3PJ8",  
"3PXF",  
"3PXQ",  
"3PXR",  
"3PXY",  
"3PXZ",  
"3PY0",  
"3PY1",  
"3QHR",  
"3QHW",  
"3QL8",  
"3QQF",  
"3QQG",  
"3QQH",
```

(continues on next page)

(continued from previous page)

```
"3QQJ",  
"3QQK",  
"3QQL",  
"3QRT",  
"3QRU",  
"3QTQ",  
"3QTR",  
"3QTS",  
"3QTU",  
"3QTW",  
"3QTX",  
"3QTZ",  
"3QU0",  
"3QWJ",  
"3QWK",  
"3QX2",  
"3QX4",  
"3QXO",  
"3QXP",  
"3QZF",  
"3QZG",  
"3QZH",  
"3QZI",  
"3R1Q",  
"3R1S",  
"3R1Y",  
"3R28",  
"3R6X",  
"3R71",  
"3R73",  
"3R7E",  
"3R7I",  
"3R7U",  
"3R7V",  
"3R7Y",  
"3R83",  
"3R8L",  
"3R8M",  
"3R8P",  
"3R8U",  
"3R8V",  
"3R8Z",  
"3R9D",  
"3R9H",  
"3R9N",  
"3R9O",  
"3RAH",  
"3RAI",  
"3RAK",  
"3RAL",  
"3RJC",  
"3RK5",  
"3RK7",  
"3RK9",  
"3RKB",  
"3RM6",  
"3RM7",
```

(continues on next page)

(continued from previous page)

```
"3RMF",  
"3RNI",  
"3ROY",  
"3RPO",  
"3RPR",  
"3RPV",  
"3RPY",  
"3RZB",  
"3S00",  
"3S00",  
"3S1H",  
"3S2P",  
"3SQQ",  
"3SW4",  
"3SW7",  
"3TI1",  
"3TIY",  
"3TIZ",  
"3TNW",  
"3ULI",  
"3UNJ",  
"3UNK",  
"3WBL",  
"4ACM",  
"4BCK",  
"4BCM",  
"4BCN",  
"4BCO",  
"4BCP",  
"4BCQ",  
"4BGH",  
"4BZD",  
"4CFM",  
"4CFN",  
"4CFU",  
"4CFV",  
"4CFW",  
"4CFX",  
"4D1X",  
"4D1Z",  
"4EK3",  
"4EK4",  
"4EK5",  
"4EK6",  
"4EK8",  
"4EOI",  
"4EOJ",  
"4EOK",  
"4EOL",  
"4EOM",  
"4EON",  
"4EOO",  
"4EOP",  
"4EOQ",  
"4EOR",  
"4EOS",  
"4ERW",
```

(continues on next page)

(continued from previous page)

```

"4EZ3",
"4EZ7",
"4FKG",
"4FKI",
"4FKJ",
"4FKL",
"4FKO",
"4FKP",
"4FKQ",
"4FKR",
"4FKS",
"4FKT",
"4FKU",
"4FKV",
"4FKW",
"4FX3",
"4GCJ",
"4I3Z",
"4II5",
"4KD1",
"4LYN",
"4NJ3",
"4RJ3",
"5A14",
"5AND",
"5ANE",
"5ANG",
"5ANI",
"5ANJ",
"5ANK",
"5ANO",
"5CYI",
"5D1J",
"5FP5",
"5FP6",
"5IEV",
"5IEX",
"5IEY",
"5IF1"
],
"pfam": "PF00069",
"pharmgkb": "PA101",
"pir": "A41227",
"prosite": "PS50011",
"reagent": {
  "GNF_Qia_hs-genome_v1_siRNA": [
    {
      "id": "GNF247215",
      "relationship": "is"
    },
    {
      "id": "GNF247216",
      "relationship": "is"
    },
    {
      "id": "GNF247217",
      "relationship": "is"
    }
  ]
}

```

(continues on next page)

```
    },
    {
      "id": "GNF247218",
      "relationship": "is"
    }
  ],
  "GNF_hs-ORFeome1_1_reads": {
    "id": "GNF161504",
    "relationship": "is"
  },
  "GNF_hs-Origene": [
    {
      "id": "GNF035860",
      "relationship": "similar to"
    },
    {
      "id": "GNF037258",
      "relationship": "is"
    },
    {
      "id": "GNF048982",
      "relationship": "is"
    }
  ],
  "GNF_hs-druggable_lenti-shRNA": [
    {
      "id": "GNF081385",
      "relationship": "is"
    },
    {
      "id": "GNF081386",
      "relationship": "is"
    },
    {
      "id": "GNF081387",
      "relationship": "is"
    }
  ],
  "GNF_hs-druggable_plasmid-shRNA": [
    {
      "id": "GNF051995",
      "relationship": "is"
    },
    {
      "id": "GNF056761",
      "relationship": "is"
    },
    {
      "id": "GNF061563",
      "relationship": "is"
    },
    {
      "id": "GNF078683",
      "relationship": "is"
    }
  ],
  "GNF_hs-druggable_siRNA": [
```

(continues on next page)

(continued from previous page)

```

    {
      "id": "GNF066537",
      "relationship": "is"
    },
    {
      "id": "GNF066538",
      "relationship": "is"
    }
  ],
  "GNF_hs-pkinase_IDT-siRNA": [
    {
      "id": "GNF166768",
      "relationship": "is"
    },
    {
      "id": "GNF166769",
      "relationship": "is"
    },
    {
      "id": "GNF166770",
      "relationship": "is"
    },
    {
      "id": "GNF166771",
      "relationship": "is"
    }
  ],
  "GNF_hs_LentiORF-HA-MYC": {
    "id": "GNF282834",
    "relationship": "is"
  },
  "GNF_hs_LentiORF-Jred": {
    "id": "GNF283761",
    "relationship": "is"
  },
  "GNF_mm+hs-MGC": {
    "id": "GNF002384",
    "relationship": "is"
  },
  "Invitrogen_IVTHSSIPkv2": [
    {
      "id": "GNF324610",
      "relationship": "is"
    },
    {
      "id": "GNF324611",
      "relationship": "is"
    }
  ],
  "NIBRI_hs-Secretome_pDEST": {
    "id": "GNF337962",
    "relationship": "is"
  },
  "NOVART_hs-genome_siRNA": [
    {
      "id": "GNF093028",
      "relationship": "is"
    }
  ]

```

(continues on next page)

(continued from previous page)

```

    },
    {
      "id": "GNF132726",
      "relationship": "is"
    }
  ]
},
"refseq": {
  "genomic": [
    "NC_000012.12",
    "NC_018923.2",
    "NG_034014.1"
  ],
  "protein": [
    "NP_001277159.1",
    "NP_001789.2",
    "NP_439892.2",
    "XP_011536034.1"
  ],
  "rna": [
    "NM_001290230.1",
    "NM_001798.4",
    "NM_052827.3",
    "XM_011537732.1"
  ],
  "translation": [
    {
      "protein": "XP_011536034.1",
      "rna": "XM_011537732.1"
    },
    {
      "protein": "NP_001789.2",
      "rna": "NM_001798.4"
    },
    {
      "protein": "NP_439892.2",
      "rna": "NM_052827.3"
    },
    {
      "protein": "NP_001277159.1",
      "rna": "NM_001290230.1"
    }
  ]
},
"reporter": {
  "HG-U133_Plus_2": [
    "204252_at",
    "211803_at",
    "211804_s_at"
  ],
  "HG-U95Av2": [
    "1792_g_at",
    "1833_at"
  ],
  "HTA-2_0": "TC12000496.hg.1",
  "HuEx-1_0": "3417146",
  "HuGene-1_1": "7956076",

```

(continues on next page)

(continued from previous page)

```

    "HuGene-2_1": "16752305"
  },
  "summary": "This gene encodes a member of a family of serine/threonine protein_
↪kinases that participate in cell cycle regulation. The encoded protein is the_
↪catalytic subunit of the cyclin-dependent protein kinase complex, which regulates_
↪progression through the cell cycle. Activity of this protein is especially critical_
↪during the G1 to S phase transition. This protein associates with and regulated by_
↪other subunits of the complex including cyclin A or E, CDK inhibitor p21Cip1_
↪(CDKN1A), and p27Kip1 (CDKN1B). Alternative splicing results in multiple transcript_
↪variants.",
  "symbol": "CDK2",
  "taxid": 9606,
  "type_of_gene": "protein-coding",
  "unigene": [
    "Hs.19192",
    "Hs.689624"
  ],
  "uniprot": {
    "Swiss-Prot": "P24941",
    "TrEMBL": [
      "A0A024RB10",
      "A0A024RB77",
      "B4DDL9",
      "E7ESI2",
      "G3V317",
      "G3V5T9"
    ]
  },
  "wikipedia": {
    "url_stub": "Cyclin-dependent kinase 2"
  }
}

```

4.5.3 Batch queries via POST

Although making simple GET requests above to our gene query service is sufficient in most of use cases, there are some cases you might find it's more efficient to make queries in a batch (e.g., retrieving gene annotation for multiple genes). Fortunately, you can also make batch queries via POST requests when you need:

```

URL: http://mygene.info/v3/gene
HTTP method: POST

```

Query parameters

ids

Required. Accept multiple geneids (either Entrez or Ensembl gene ids) seperated by comma, e.g., 'ids=1017,1018' or 'ids=695,ENSG00000123374'. Note that currently we only take the input ids up to **1000** maximum, the rest will be omitted.

fields

Optional, can be a comma-separated fields to limit the fields returned from the matching hits. If “fields=all”, all available fields will be returned. Note that it supports dot notation as well, e.g., you can pass “refseq.rna”. Default: “symbol,name,taxid,entrezgene”.

species

Optional, can be used to limit the gene hits from given species. You can use “common names” for nine common species (human, mouse, rat, fruitfly, nematode, zebrafish, thale-cress, frog and pig). All other species, you can provide their taxonomy ids. See [more details here](#). Multiple species can be passed using comma as a separator. Passing “all” will query against all available species. Default: all.

dotfield

Optional, can be used to control the format of the returned fields when passed “fields” parameter contains dot notation, e.g. “fields=refseq.rna”. If “dotfield” is true, the returned data object contains a single “refseq.rna” field, otherwise, a single “refseq” field with a sub-field of “rna”. Default: false.

email

Optional, if you are regular users of our services, we encourage you to provide us an email, so that we can better track the usage or follow up with you.

Example code

Unlike GET requests, you can easily test them from browser, make a POST request is often done via a piece of code, still trivial of course. Here is a sample python snippet:

```
import requests
headers = {'content-type': 'application/x-www-form-urlencoded'}
params = 'ids=1017,695&fields=name,symbol,refseq.rna'
res = requests.post('http://mygene.info/v3/gene', data=params, headers=headers)
```

Returned object

Returned result (the value of “res.text” variable above) from above example code should look like this:

```
[
  {
    '_id': '1017',
    '_score': 21.731894,
    'name': 'cyclin dependent kinase 2',
    'query': '1017',
    'refseq': {
      'rna': [
        'NM_001290230.1',
        'NM_001798.4',
        'NM_052827.3',
        'XM_011537732.1'
      ]
    }
  }
]
```

(continues on next page)

(continued from previous page)

```

    ]
  },
  'symbol': 'CDK2'
},
{
  '_id': '695',
  '_score': 21.730501,
  'name': 'Bruton tyrosine kinase',
  'query': '695',
  'refseq': {
    'rna': [
      'NM_000061.2',
      'NM_001287344.1',
      'NM_001287345.1'
    ]
  }
},
'symbol': 'BTK'
}
]

```

4.6 Server response

The MyGene.info server returns a variety of query responses, and response status codes. They are listed here.

Note: These examples show query responses using the python `requests` package.

4.6.1 Status code 200

A **200** status code indicates a successful query, and is accompanied by the query response payload.

```

In [1]: import requests

In [2]: r = requests.get('http://mygene.info/v3/query?q=_exists_:entrezgene')

In [3]: r.status_code
Out[3]: 200

In [4]: data = r.json()

In [5]: data.keys()
Out[5]: dict_keys(['total', 'max_score', 'took', 'hits'])

```

4.6.2 Status code 400

A **400** status code indicates an improperly formed query, and is accompanied by a response payload describing the source of the error.

```

In [6]: r = requests.get('http://mygene.info/v3/query?q=_exists_:entrezgene&size=u')

```

(continues on next page)

(continued from previous page)

```
In [7]: r.status_code
Out[7]: 400

In [8]: data = r.json()

In [9]: data
Out[9]:
{'error': "Expected 'size' parameter to have integer type.  Couldn't convert 'u' to_
↪integer",
 'success': False}
```

4.6.3 Status code 404

A **404** status code indicates either an unrecognized URL, as in (*/query* is misspelled */quer* resulting in an unrecognized URL):

```
In [10]: r = requests.get('http://mygene.info/v3/quer?q=_exists_:entrezgene')

In [11]: r.status_code
Out[11]: 404
```

or, for the **/gene** endpoint, a **404** status code could be from querying for a nonexistent gene ID, as in:

```
In [12]: r = requests.get('http://mygene.info/v3/gene/0')

In [13]: r.status_code
Out[13]: 404

In [14]: data = r.json()

In [15]: data
Out[15]:
{'error': "Gene ID '0' not found",
 'success': False}
```

4.6.4 Status code 5xx

Any **5xx** status codes are the result of uncaught query errors. Ideally, these should never occur. We routinely check our logs for these types of errors and add code to catch them, but if you see any status **5xx** responses, please submit a bug report to help@mygene.info.

4.7 Usage and Demo

This page provides some usage examples and demo applications.

4.7.1 Call from web applications

You can call MyGene.info services from either server-side or client-side (via AJAX). The sample code can be found at “*demo*” section.

Calling services from server-side

All common programming languages provide functions for making http requests and JSON parsing. For Python, you can use built-in `httplib` and `json` modules (v2.6 up), or third-party `httplib2` and `simplejson` modules. For Perl, `LWP::Simple` and `JSON` modules should work nicely.

Making AJAX calls from client-side

When making an AJAX call from a web application, it is restricted by “same-origin” security policy, but there are several standard ways to get it around.

Making your own server-side proxy

To overcome “same-origin” restriction, you can create proxy at your server-side to our services. And then call your proxied services from your web application.

Setup proxy in popular server-side applications, like `Apache`, `Nginx` and `PHP`, are straightforward.

Making JSONP call

Because our core services are just called as simple GET http requests (though we support POST requests for batch queries too), you can bypass “same-origin” restriction by making JSONP call as well. To read more about JSONP, see [1](#), [2](#), or just Google about it. All our services accept an optional “**callback**” parameter, so that you can pass your callback function to make a JSONP call.

All popular javascript libraries have the support for making JSONP calls, like in `JQuery`, `ExtJS`, `MooTools`

Cross-origin http request through CORS

Cross-Origin Resource Sharing (CORS) specification is a [W3C draft specification](#) defining client-side cross-origin requests. It’s actually supported by all major browsers by now (Internet Explorer 8+, Firefox 3.5+, Safari 4+, and Chrome. See more on [browser support](#)), but not many people are aware of it. Unlike JSONP, which is limited to GET requests only, you can make cross-domain POST requests as well. Our services supports CORS requests on both GET and POST requests. You can find more information and use case [here](#) and [here](#).

JQuery’s native ajax call supports CORS since v1.5.

4.7.2 Demo Applications

In this demo, we want to create a web site to display expression charts from a microarray dataset (Affymetrix MOE430v2 chip). The expression data are indexed by porobeset ids, but we need to allow users to query for any mouse genes using any commonly-used identifiers, and then display expression charts for any selected gene.

We implemented this demo in four ways:

Example 1: using CGI

- [Download sample code here.](#)

- It's a simple python CGI script. To run it, you just need to drop it to your favorite web server's cgi-bin folder (make sure your python, v2.6 up, is in the path).
- [See it in action here.](#)

Example 2: using tornado

- [Download sample code here.](#)
- This single python script can be used to run a standalone website. Just run: `python mygene_info_demo_tornado.py`. You then have your website up at `http://localhost:8000`.

Besides python (v2.6 up), you also need `tornado` to run this code. You can either install it by your own (`pip install tornado`), or download [this zip file](#), which includes tornado in it.

- [See it in action here.](#)

Example 3: using JSONP

- [Download sample code here.](#)
- The zip file contains one html file and one javascript file. There is no server-side code at all. To run it, just unzip it and open the html file in any browser. All remote service calls are done at client side (via browsers). Put the files into any web server serving static files will allow you to publish to the world.
- [See it in action here.](#)

Example 4: using CORS

- [Download sample code here.](#)
- The zip file contains one html file and one javascript file. There is no server-side code at all. To run it, just unzip it and open the html file in any browser. All remote service calls are done at client side (via browsers). Put the files into any web server serving static files will allow you to publish to the world.
- This demo is almost the same as the one using JSONP, except that the actual AJAX call to MyGene.info server is made via CORS.
- [See it in action here.](#)

4.7.3 Autocomplete widget for gene query

When you build a web application to have users to query for their favorite genes, the autocomplete widget is very useful, as it provides suggestions while users start to type into the field.

Note: The autocomplete widget below is a simple demo application. You may also want to have a look at [this more sophisticated autocomplete widget](#), which comes with a lot more customization options.

Try it live first

About this widget

This autocomplete widget for gene query provides suggestions while you type a gene symbol or name into the field. Here the gene suggestions are displayed as “<Symbol>:<Name>”, automatically triggered when at least two characters are entered into the field.

At the backend, this widget is powered by [the gene query web service](#) from MyGene.info. By default, the gene suggestions display human genes only.

Use it in your website

To use this widget in your own website is very easy, just following these three steps:

1. Copy/paste this line into your html file:

```
<script src="http://mygene.info/widget/autocomplete/js/mygene_query_min.js" type=
↪"text/javascript"></script>
```

Hint: if you prefer an un-minified javascript file, using “mygene_query.js” instead.

2. Add “mygene_query_target” class to your target input element:

```
<input id="gene_query" style="width:250px" class="mygene_query_target">
```

so that we know which input field to enable autocomplete.

3. Define your own callback function, which is triggered after user selects a gene. For example:

```
<script type="text/javascript">
  mygene_query_select_callback = function(event, ui){
    alert( ui.item ?
      "Selected: " + ui.item.label + '('+ui.item.entrezgene+')':
      "Nothing selected, input was " + this.value);
  };
</script>
```

As shown in above example, you can access the gene object as **ui.item**:

```
ui.item._id      gene id
ui.item.value    gene symbol
ui.item.label    the label displayed in autocomplete dropdown list
```

Note: if you don’t define your own callback function (like the minimal HTML page below), the default behavior is to display an alert msg with the gene selected. To change this default behavior, you must overwrite with your own callback function (keep the same name as “mygene_query_select_callback”).

A minimal HTML page with autocomplete enabled looks just like this ([See it in action here](#)):

```
<html>
<body>
  <label for="gene_query">Enter a gene here: </label>
```

(continues on next page)

(continued from previous page)

```

<input style="width:250px" class="mygene_query_target">
<script src="http://mygene.info/widget/autocomplete/js/mygene_query_min.js" type=
↪"text/javascript"></script>
</body>
</html>

```

Have fun! And send us feedback at help@mygene.info.

4.8 Third-party packages

This page lists third-party packages/modules built upon MyGene.info services.

4.8.1 MyGene python module

“mygene” is an easy-to-use Python wrapper to access MyGene.info services.

You can install it easily using either `pip` or `easy_install`:

```
pip install mygene #this is preferred
```

or:

```
easy_install mygene
```

This is a brief example:

```

In [1]: import mygene

In [2]: mg = mygene.MyGeneInfo()

In [3]: mg.getgene(1017)
Out[3]:
{'_id': '1017',
 'entrezgene': 1017,
 'name': 'cyclin-dependent kinase 2',
 'symbol': 'CDK2',
 'taxid': 9606}

In [4]: mg.query('cdk2', size=2)
Out[4]:
{'hits': [{'_id': '1017',
            '_score': 373.24667,
            'entrezgene': 1017,
            'name': 'cyclin-dependent kinase 2',
            'symbol': 'CDK2',
            'taxid': 9606},
          {'_id': '12566',
            '_score': 353.90176,
            'entrezgene': 12566,
            'name': 'cyclin-dependent kinase 2',
            'symbol': 'Cdk2',
            'taxid': 10090}],
 'max_score': 373.24667,

```

(continues on next page)

(continued from previous page)

```
'took': 10,
'total': 28}
```

See <https://pypi.python.org/pypi/mygene> for more details.

4.8.2 MyGene R package

An R wrapper for the MyGene.info API is available in Bioconductor since v3.0. To install:

```
source("https://bioconductor.org/biocLite.R")
biocLite("mygene")
```

To view documentation for your installation, enter R and type:

```
browseVignettes("mygene")
```

For more information, visit the [Bioconductor mygene page](#).

4.8.3 MyGene autocomplete widget

This autocomplete widget for gene query (built upon [jQueryUI's autocomplete widget](#)) provides suggestions while you type a gene symbol or name into the field. You can easily embed it into your web application. It also provides many customization options for your different use-cases.

See <https://bitbucket.org/sulab/mygene.autocomplete/overview> for more details.

You can also play with this [jsFiddle](#) example:

4.8.4 Another MyGene Python wrapper

This is yet another Python wrapper of MyGene.info services created by [Brian Schrader](#). It's hosted at <https://github.com/Sonictherocketman/mygene-api>.

It's available from [PyPI](#) as well:

```
pip install mygene-api
```

Some basic examples:

- Find a given gene with the id: CDK2.

```
""" Use the query API to find a gene with
the given symbol.
"""
from mygene.gene import Gene

results = Gene.find_by(q='CDK2')
for r in result:
    print r._id, r.name

>>> 1017 cyclin-dependent kinase 2
12566 cyclin-dependent kinase 2
362817 cyclin dependent kinase 2
```

(continues on next page)

(continued from previous page)

```
52004 CDK2-associated protein 2
...
```

- Given an known gene, get it's begin and end coordinates.

```
""" Use the annotation API to find the full
details of a given gene.
"""
from mygene.gene import gene

gene = Gene.get('1017')
print gene._id, gene.genomic_pos_hg19['start'], gene.genomic_pos_hg19['end']

>>> 1017 56360553 56366568
```

- This library also supports the metadata API.

```
from mygene.metadata import Metadata

metadata = Metadata.get_metadata()
print metadata.stats['total_genes']

>>> 12611464
```

4.9 Terms of Use

The MyGene.info website (“MyGene.info”) has been designed to provide you with access to gene-centric annotation data that are maintained by The Scripps Research Institute (“TSRI”). TSRI authorizes you to access and use MyGene.info and the data and information contained on this MyGene.info website and database under the conditions set forth below.

You also agree that you will ensure that any copies of documents you generate by using MyGene.info shall retain and display all copyright and other proprietary notices contained therein. TSRI has attempted to provide accurate and current information on MyGene.info. However, TSRI makes no representations or warranties that the information contained or published on MyGene.info will be suitable for your specific purposes or for any other purposes. You agree to indemnify, defend, and hold TSRI harmless from all claims, damages, liabilities and expenses, including without limitation reasonable attorney’s fees and costs, whether or not a lawsuit or other proceeding is filed, that in any way arise out of or relate to your use of MyGene.info and/or use of the other third party websites referenced herein.

ALL INFORMATION AND DATA PROVIDED ON MYGENE.INFO IS PROVIDED “AS-IS” WITHOUT WARRANTY OF ANY KIND. TSRI MAKES NO REPRESENTATIONS OR WARRANTIES CONCERNING MYGENE.INFO OR ANY OTHER MATTER WHATSOEVER, INCLUDING WITHOUT LIMITATION ANY EXPRESS, IMPLIED OR STATUTORY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT OF THIRD PARTY RIGHTS, TITLE, ACCURACY, COMPLETENESS OR ARISING OUT OF COURSE OF CONDUCT OR TRADE CUSTOM OR USAGE, AND DISCLAIMS ALL SUCH EXPRESS, IMPLIED OR STATUTORY WARRANTIES. TSRI MAKES NO WARRANTY OR REPRESENTATION THAT YOUR USE OF MYGENE.INFO WILL NOT INFRINGE UPON THE INTELLECTUAL PROPERTY OR OTHER RIGHTS OF ANY THIRD PARTY. FURTHER, TSRI SHALL NOT BE LIABLE IN ANY MANNER WHATSOEVER FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES ARISING OUT OF OR IN ANY WAY RELATED TO MYGENE.INFO, THE USE OF, OR INABILITY TO USE, ANY OF THE INFORMATION OR DATA CONTAINED OR REFERENCED IN THIS WEBSITE OR ANY INFORMATION OR DATA THAT IS PROVIDED THROUGH LINKED WEBSITES, OR ANY OTHER MATTER. THE FOREGOING EXCLUSIONS AND LIMITATIONS SHALL APPLY TO ALL CLAIMS

AND ACTIONS OF ANY KIND AND ON ANY THEORY OF LIABILITY, WHETHER BASED ON CONTRACT, TORT OR ANY OTHER GROUNDS, AND REGARDLESS OF WHETHER A PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, AND NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY. BY USING THIS WEBSITE, YOU FURTHER AGREE THAT EACH WARRANTY DISCLAIMER, EXCLUSION OF DAMAGES OR OTHER LIMITATION OF LIABILITY HEREIN IS INTENDED TO BE SEVERABLE AND INDEPENDENT OF THE OTHER CLAUSES OR SENTENCES BECAUSE THEY EACH REPRESENT SEPARATE ELEMENTS OF RISK ALLOCATION BETWEEN THE PARTIES.

MyGene.info may contain information from third party websites, which may or may not be marked with the name of the source. Such information does not necessarily represent the views or opinions of TSRI, and TSRI shall have no responsibility whatsoever for such information. All information from third party websites are the sole responsibility of the person or entity that provides and/or maintains such website. As a MyGene.info user, you are solely responsible for any information that you display, generate, transmit or transfer while using MyGene.info, and for the consequences of such actions.

Should any MyGene.info user provide general, scientific or other feedback information, whether in the form of questions, comments, or suggestions to TSRI, regarding the content of TSRI's website or otherwise, such information shall not be deemed to be confidential or proprietary to you or to any other party. TSRI shall have no obligation of any kind with respect to such information and TSRI shall have the right, without limitation, to reproduce, use, disclose, merge, display, make derivatives of and distribute such information to others. TSRI shall also have the right, without limitation, to use and exploit such information, including ideas, concepts, know-how, inventions, techniques or other materials contained in such information for any purpose whatsoever, including but not limited to, making changes or improvements to MyGene.info and/or developing, manufacturing, marketing, selling or distributing products and technologies incorporating such information. However, you agree that TSRI has no obligation whatsoever to respond to your comments or to change or correct any information on MyGene.info based on your comments.

TSRI reserves the right to alter the content of MyGene.info in any way, at any time and for any reason, with or without prior notice to you, and TSRI will not be liable in any way for possible consequences of such changes or for inaccuracies, typographical errors or omissions in the contents hereof. Nothing contained herein shall be construed as conferring by implication, estoppel or otherwise any license or right under any patent, trademark or other intellectual property of TSRI or any third party. Except as expressly provided above, nothing contained herein shall be construed as conferring any right or license under any TSRI copyrights.

TSRI also reserves the right to modify these Terms of Use at any time and for any reason, with or without prior notice to you. You should always review the most current Terms of Use herein before using this website. By using this website, you agree to the current Terms of Use posted on this site. You also agree that these Terms of Use constitute the entire agreement between you and TSRI regarding the subject matter hereof and supersede all prior and contemporaneous understandings, oral or written, regarding such subject matter. In addition, if any provision of these Terms of Use is found by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall remain in full force and effect, and the affected provision shall be revised so as to reflect the original intent of the parties hereunder to the maximum extent permitted by applicable law.

BY USING THIS WEBSITE, YOU ACKNOWLEDGE AND AGREE THAT YOU HAVE READ, UNDERSTOOD AND AGREE TO ALL OF THESE TERMS OF USE.

CHAPTER 5

How to cite

See citation page here: <http://mygene.info/citation/>

CHAPTER 6

FAQ

See FAQ page here: <http://mygene.info/faq/>

CHAPTER 7

Related links

- [mygene.info on Github](#)

CHAPTER 8

Contact us

- help@mygene.info
- [@mygeneinfo](#)