

# A formalization of one of the main claims of “Sonic hedgehog signaling in astrocytes” by Hill et al. 2021<sup>1</sup>

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**Abstract.** Hill et al. claimed in previous work that sonic hedgehog signalling pathway is an essential regulator of astrocytes development. We present here a formalization of that claim, stating that all things of class “smoothened signaling pathway” that are in the context of a thing of class “human” mostly have a relation of type “affects” to a thing of class “astrocyte development” in the same context.

Keywords: Human, smoothened signaling pathway, astrocyte development

## 1. Introduction

Hill et al. [2] state that “Shh signaling and emerging data point to essential roles for this pleiotropic signaling pathway in regulating various functional properties of astrocytes.”. We present here a formalization of the main scientific claim from this quote by using a semantic template called the super-pattern [1].

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<sup>1</sup>As RDF/nanopublication: [http://purl.org/np/RA1FoHM9lwJ1XAV1eB871XcMAKfod73G\\_i4YtgoLpJVH0](http://purl.org/np/RA1FoHM9lwJ1XAV1eB871XcMAKfod73G_i4YtgoLpJVH0)

## 2. Formalization

Our formalization looks as follows:

CONTEXT-CLASS (“in the context of all ...”):	human
SUBJECT-CLASS (“things of type ...”):	smoothened signaling pathway
QUALIFIER:	mostly
RELATION-TYPE (“have a relation of type ...”):	affects
OBJECT-CLASS (“to things of type ...”):	astrocyte development

In the context class we use the “human” (Q5) class from Wikipedia. In subject class, we use the “smoothened signaling pathway” (GO:0007224) from GeneOntology. In the object class we used the “astrocyte development” (GO:0014002) class from GeneOntology.

## 3. RDF code

This is our formalization as a nanopublication in TriG format:

```
@prefix this: <http://purl.org/np/RA1FoHM91wJ1XAV1eB871XcMAKfod73G_i4YtgoLpJVH0> .
@prefix sub: <http://purl.org/np/RA1FoHM91wJ1XAV1eB871XcMAKfod73G_i4YtgoLpJVH0#> .
@prefix np: <http://www.nanopub.org/nschema#> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix nt: <https://w3id.org/np/o/n-template/> .
@prefix npx: <http://purl.org/nanopub/x/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix orcid: <https://orcid.org/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix sp: <https://w3id.org/linkflows/superpattern/terms/> .

sub:Head {
  this: np:hasAssertion sub:assertion ;
  np:hasProvenance sub:provenance ;
  np:hasPublicationInfo sub:pubinfo ;
  a np:Nanopublication .
}
sub:assertion {
  sub:spi a <https://w3id.org/linkflows/superpattern/terms/SuperPatternInstance> ;
  rdfs:label "Sonic hedgehog signalling pathway is an essential regulator of astrocytes development." ;
  sp:hasContextClass <http://www.wikidata.org/entity/Q5> ;
  sp:hasSubjectClass <http://purl.obolibrary.org/obo/GO_0007224> ;
  sp:hasQualifier sp:mostlyQualifier ;
  sp:hasRelation sp:affects ;
  sp:hasObjectClass <http://purl.obolibrary.org/obo/GO_0014002> .
}
sub:provenance {
  sub:activity a sp:FormalizationActivity ;
  prov:used sub:quote , <https://link.springer.com/article/10.1007%2Fs00018-020-03668-8> ;
  prov:wasAssociatedWith orcid:0000-0001-8004-0464 .
  sub:assertion prov:wasGeneratedBy sub:activity .
  sub:quote prov:value "Shh signaling and emerging data point to essential roles for this pleiotropic signaling pathway in regulating various functional properties of astrocytes." ;
  prov:wasQuotedFrom <https://link.springer.com/article/10.1007%2Fs00018-020-03668-8> .
}
sub:pubinfo {
  sub:sig npx:hasAlgorithm "RSA" ;
  npx:hasPublicKey
  "MIGfMA0GCSqGSIb3DQEBQUAA4GNADCBiQKBgQDs0t7015Wx/NFoleAZFCOuayiJlHtJ7daow/5JX9WuaUi0hjKn+wPdhgxDuxQvTPQIe8D6JE1LZnY2LXBSOzDc
  HKn+QWB6Zkn/ZisiG24V5C0kGpNji6Ab0gaAFZY132VdS0qLPr34LLsEDZJRuozZHwXg0KoHw85F0EzlrPH+JpwIDAQAB" ;
  npx:hasSignature
  "k7zk9oeQr6IarkWA3guYqppm8oIdPR8cWvcJWsi+iyQUXLG3s7BOD5oqApzfTQ0BYw191ZiIO5kYyJ4sob/m41JSUc6AQ3XqNbgg5hIsL/F5EUo9XpL511yLMyV
  KJ054/HrTvDw0oip/0Z4KKmRPse7PeyE9b6fOMj/wz8jAo=" ;
  npx:hasSignatureTarget this: .
  this: dct:created "2021-10-20T12:00:18.181+02:00"^^xsd:dateTime ;
  dct:creator orcid:0000-0001-8004-0464 ;
  npx:introduces sub:spi ;
  <https://w3id.org/linkflows/reviews/isUpdateOf> <http://purl.org/np/RamfrSLt-WVQVNTTrJi6l1nk3ZiQyYBds0NYGJpUBesPjFI> ;
  nt:wasCreatedFromProvenanceTemplate <http://purl.org/np/RAB_oy10D3XUP-zY1qGz7Uj58AsUXhEKeGqmRFp5LsGDM> ;
}
```

```
nt:wasCreatedFromPubinfoTemplate <http://purl.org/np/RAA2MfqdBCzmz9yVwjKLXNbyfBNcwsMmOqcNUxkk1maIM> ,  
<http://purl.org/np/RAOGu9Lh0BD4tbIRB9RG6RGRA_ObDh75NTbIqaWgxxs8M> ;  
nt:wasCreatedFromTemplate <http://purl.org/np/RAv68imZrEjfc2rnEg1hzoBqEVc0cQMtp9_1Za0BxNM4> .  
}
```

## References

- [1] C.I. Bucur, T. Kuhn, D. Ceolin and J. van Ossenbruggen, Expressing high-level scientific claims with formal semantics, in: *Proceedings of the 11th Knowledge Capture Conference*, 2021. doi:[10.1145/3460210.3493561](https://doi.org/10.1145/3460210.3493561).
- [2] S.A. Hill, M. Fu and A.D.R. Garcia, Sonic hedgehog signaling in astrocytes, *Cell. Mol. Life Sci.* **78** (2021), 1393–1403. doi:[10.1007/s00018-020-03668-8](https://doi.org/10.1007/s00018-020-03668-8).