

## Noggin Consistently Suppresses Differentiation of Human Embryonic Stem Cells

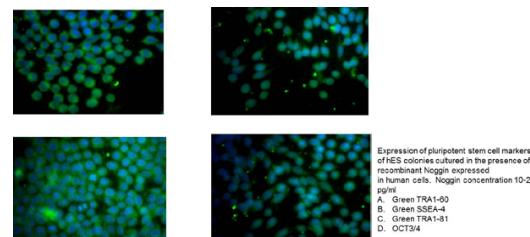
### INTRODUCTION

Recombinant human cytokines are essential for the expansion and differentiation of human stem cells. As stem cell research continues to advance and findings are translated to the clinic, there is a growing need for recombinant cytokines to support the clinical development of cellular therapies. United States Biological has developed an efficient human-cell based technology for the scalable production of human cytokines. An expanding range of authentic, tag-free cytokines is available, including difficult-to-express protein members of the TGF $\beta$ 1 superfamily. United States Biological's authentic cytokines can be used as cost effective, highly preferred reagents for stem cell research and clinical development.

### Biologically Relevant Noggin

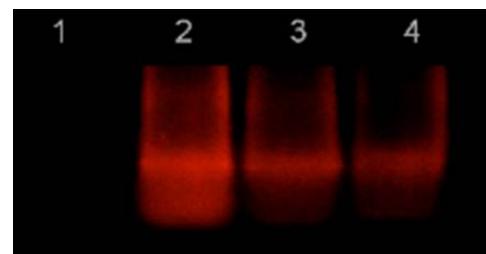
Noggin is a secreted homodimeric glycoprotein that is an antagonist of bone morphogenetic proteins (BMPs). During culture of human embryonic stem (hES) cells without feeder layers or conditioned medium (but with addition of FGF basic) the addition of Noggin allows the stem cells to maintain their undifferentiated pluripotent state. Commercially available Noggin products are produced in a variety of forms none of which are authentic: non-glycosylated protein expressed in *E. coli* and glycosylated Fc-fusion protein expressed in NS0, for example. United States Biological has produced Noggin in a stable, engineered human 293 cell expression system. The protein is expressed as an authentic glycosylated, disulfide-linked dimer. The bioactivity of Noggin was initially determined by the dose-dependent inhibition of BMP-4 induced alkaline phosphate production by ATDC5 cells. More importantly, as shown in the figure, hES cells in the presence of Noggin exhibit high expression of surface markers typical of

undifferentiated stem cells: TRA1-60, TRA1-81, SSEA-4 and transcriptional factors OCT3/4.



However, these markers are normally only inconsistently detectable when recombinant Noggin from a non-human cells expression system is used at substantially higher concentration, making large scale cell culture un-economical.

This product adds to the rapidly expanding range of stem cell related cytokines available from United States Biological manufactured to high quality standards and providing high biological activity, lot-to-lot consistency and low endotoxin levels. See product number N3100-05E at [www.usbio.net](http://www.usbio.net).



Western Blot Analysis of OCT3/4

1. Negative Control
2. Positive Control -OCT3/4
3. Human Embryonic Stem Cells Treated with 10 pg/ml Noggin
4. Human Embryonic Stem Cell sTreated with 20 pg/ml Noggin