



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

Name(s) Elisha D. Johnston	Project Number J0505
Project Title The Molecular Mechanisms of Regenerating Cartilage to Reduce Chronic Pain: Phenol-Glucose-Glycerin Upregulates FGF-2	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals To study the molecular mechanisms of cartilage regeneration. Specifically, I am interested to model a medical treatment called prolotherapy, in which a physician injects a phenol, glucose, and glycerin compound (P2G) inside a joint to regenerate cartilage. Newly published and compelling clinical evidence demonstrates prolotherapy regenerates cartilage, so the medical research community is now very interested in figuring out the mechanism of action. My hypothesis is that P2G upregulates Fibroblast Growth Factor 2 (FGF-2) expression, leading to cell proliferation.</p> <p>Methods/Materials I use a preosteoblastic murine in vitro model capable of assessing regeneration rates. To gather experimental data, I utilize quantitative Reverse Transcriptase Polymerase Chain Reaction (qRT-PCR). I use Microsoft Excel 2013 to compute t-tests and consider a p-value less than 0.05 as statistically significant.</p> <p>Results As hypothesized, qRT-PCR reveals that P2G upregulates FGF-2 expression after treatment (hours 24, 30, and 38 [p<0.05]). I also find that Cyclin D1 is upregulated at hour 30 (p<0.05). Upregulation of Cyclin D1 is consistent with my hypothesis because Cyclin D1 is a proliferation gene downstream of FGF-2.</p> <p>Conclusions/Discussion These novel findings illuminate the molecular mechanisms by which phenol-glucose-glycerin (prolotherapy) regenerates cartilage (P2G upregulates FGF-2 expression which triggers cell proliferation). My study points to the engineering of a new clinical tool that assesses FGF-2 and additional proteins to indicate if prolotherapy treatment is regenerating cartilage.</p>	
Summary Statement I investigated a cartilage regenerating treatment that has an unknown mechanism of action (Phenol-Glucose-Glycerin) and showed that the treatment upregulates FGF-2 expression.	
Help Received Dr. Cory Tobin enabled me to conduct cell culture and qRT-PCR in TheLab. Mr. Nam Che provided on-site coaching. Dr. Rajendra Gangalum, Becky Maxen, and Mike Hagen consulted on research design and interpretation of results.	